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Engineering News-Record

Staff Reports of Two Conventions

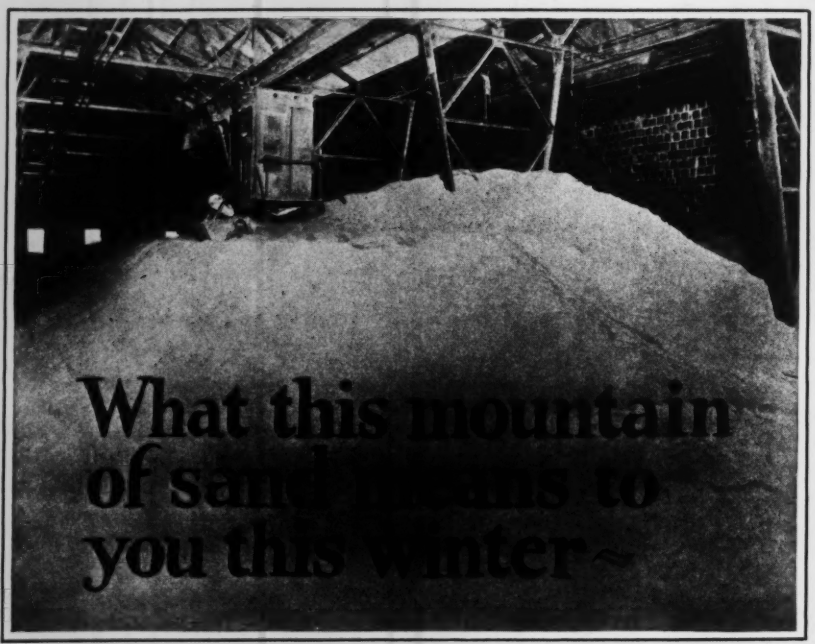
American Society of Civil Engineers
American Road Builders' Association

Davis Bridge Power Project to Develop 50,000 Horsepower

By A. C. Eaton

Through Truss Spans Converted to Deck Girder Viaduct

Rebuilding Chicago Elevated Railway Structure



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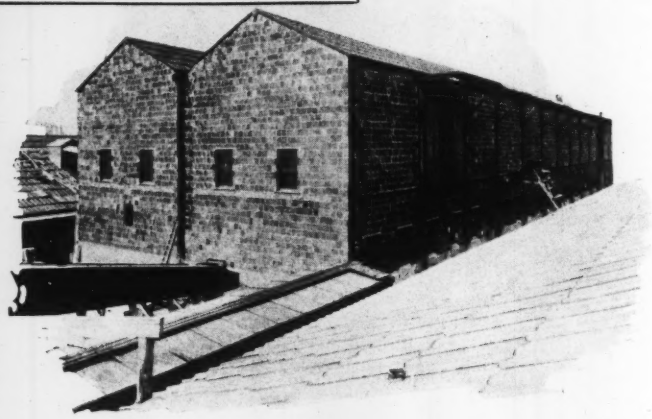

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Only A Billion

COL. PHILIPPE BUNAU-VARILLA is in the United States again advocating his "Straits of Panama." He now wants a 50-ft. channel, 1,000 ft. wide at the level of the sea and he says that it can readily be built for a billion dollars in twenty years. Further, it will not cost the people of this country a cent because the profits of the canal in the twenty years will pay for it. Whether or not this is good engineering or good politics, it is bad bookkeeping. If the Panama Canal will profit the United States a billion dollars in twenty years—which is doubtful because last year the book profits, not charging anything to the heavy amortization, were only six million—there are several better places where the United States might spend the money in public work. There is the St. Lawrence project, for instance, or the Colorado River, the Columbia Basin or the other many projects of the arid West, the Mississippi River, the cut-over lands of the North or the swamps of the South. There are dozens of good national projects just waiting for a billion dollars to be spent on them to the greater good of the citizens of this country than would be gained by a sea-level route through Panama. A billion dollars is a billion dollars, even in the richest country in the world.

Inspiration

AT WASHINGTON two weeks ago the guests at the dinner of the American Engineering Council were privileged to listen to two very remarkable addresses, by Herbert Hoover and by Nicholas Murray Butler. They are presented, in the most part, on another page of this issue. We have heard a great deal these past few years of the place of the engineer in the world, but over most of us there has come a vast depression when we thought how far short of the ideal of service and of position the engineer and engineering of today falls. We need the inspiration of such speeches as these two, to point the way ahead, to give courage to those who feel that the engineer has some obligation beyond his own personal need and desire, and, in the case of Dr. Butler, to show that the thinking leaders outside the engineering profession are looking toward that profession for leadership through our complicating social and economic maze. The goal is fairly clear; the way to take is still obscure and dark.

Federation's Final Effort

AT THIS same meeting at Washington the Federated American Engineering Societies became a thing of the past and the American Engineering Council took its place. The change is little more than name, though a new constitution was written requiring proper engineering qualifications for the directing heads of the body and a two-thirds vote of its several parts for any action regarding policy or practice. In everything but the spirit of its leaders the meeting at which the change was wrought was discouraging. One more of the four major engineering societies has withdrawn, leaving the mechanicals and the electricals carrying eighty per cent of the burden of the cost of the Council, the budget had to be cut to the reduced income and the proceedings in the delegate body were so inconsequential and of such routine character as to make the unprejudiced observer question the theory of the organization and its right to existence. But those who believe in the federation idea held their heads high and followed the gleam. Heartened by the call to service in Secretary Hoover's brilliant speech, they refuse to be discouraged. The ideal set by Mr. Hoover is to infuse the engineer with a sense of public responsibility and public service, but, it must be said, that ideal was only vaguely approached by the mechanism of the federation or by its performance. For that reason many engineers, including the majority in the American Society of Civil Engineers, want to scrap the whole machine and start afresh. That start cannot be made until those behind the Council agree, and the meeting at Washington showed that they are not yet ready to do so. They are entitled to put forth now the final effort which must lead shortly either to success or confessed failure.

Warming Up on Muscle Shoals

ONCE more Muscle Shoals takes the center of the legislative stage. The Secretary of War is being deluged with offers and rumors of offers in competition with the famous one by Henry Ford. And for publication, at least, the Detroit billionaire sticks to his original proposal, regardless of the fact that the return to the government would be many millions less than that promised by any of the several other plans. Mr. Ford is wise. He knows that the present Congress wants to please the farmer, not the user of power, and he knows that his scheme is the only one which promises any prospects of fertilizer production, which is the bait he holds out for the agricultural interests. Before any plan for the utilization of power will be accepted it must be tied up to some definite nitrate production, not merely a promise of cheap power to prospective nitrate producers. This is so obvious, as a matter of political and legislative strategy, that doubtless before long we will see presented a proposal for a combination of power and nitrate that will put the Ford offer on the defensive.

The Test of Emergency

PROBABLY few people were greatly surprised when the giant dirigible "Shenandoah" had its mishap last week, tearing loose from its moorings at Lakehurst and blowing away in the darkness. The flimsy-appearing sheetmetal framework supporting an acre of exposed sail area never inspired much confidence, certainly not enough to overcome prejudices engendered by the wrecking of many earlier airships. So the headline news of last week that the Jan. 16 storm blew the ship

away came as a natural confirmation of what many had expected. But upon the "Shenandoah's" returning a few hours later under its own engines and rudder, still capable of maneuvering through a fifty-mile gale, the whole aspect of the case was altered, and it is now clear that the ship gave a splendid demonstration of strength and sturdiness. Not only did it prove capable of outriding a whole gale, and beating home to a landing in the teeth of the wind, but, which is even greater, it withstood the terrific wrenching of having its nose-cap torn away and the foreward end of the hull framing left hanging loose and unconnected. The test of emergency was real and severe, and ship as well as crew proved itself worthily. On its showing in this test the "Shenandoah" may look forward to a long and honorable career.

Looking Ahead in Traffic Control

TRAFFIC control in our city streets is coming into its own as an engineering problem. The discussion at the City Planning Division of the American Society of Civil Engineers last week showed that. Not only in the thoughtful prepared papers and addresses but in the long and interesting discussion was there evidence of the impress that engineers are soon to make on this most troublesome problem of our cities. Two things stand out clearly from the meeting. First, that relief must first be sought by some means other than the construction of new streets ruthlessly cut through property already expensively improved, and second, that engineering opinion is inevitably tending toward the removal of certain kinds of vehicle traffic from crowded streets as the first step toward relief. The papers by Mr. Tuttle and Mr. Corbett pointed out clearly how our existing streets can be widened and lowered and raised —all three—to accommodate the wheel, rail and foot passengers who use them. The floor discussion indicated how expensive such measures must be, and how impossible for the present in any but our richest cities, and pointed to the obvious remedy of keeping away from those streets the vehicles that have no business on them. Zoning has so far applied mainly to the type of buildings and business in certain districts; it is going to be applied to the kind of traffic. The passenger automobile carrying one or two people in a space which could readily carry ten times that number has no rights that the general public is bound to respect, and its removal from congested districts, whether it be moving or parked, is inevitable.

The Good Roads Show

LAST week's Good Roads Show in Chicago did more than assemble in great number and variety the improved equipment and materials of more than 200 manufacturers whose products are aiding the prosecution of the vast program of highway development to which the nation is committed. The chief object of such an exhibit is to bring together the maker and the user of equipment—to offer contractor and engineer an opportunity of inspecting and comparing machines or materials of different types so that purchases may be made of those products best adapted to their particular needs. That object was accomplished. The show attracted a record throng of spectators—not the inquisitive layman or the school-boy out to collect an armful of catalogs—but real road-builders charged with the responsibility of getting results for the huge outlay which is going into improved highways. The exhibit, which is the subject of a detailed report on another page of this issue, was an educational agency of broad scope. It preached economies in time and labor through the use of mechanical devices. It offered counsel in the selection and use of materials. It established contact between operator and designer, to their mutual advantage. It hastened progress by stimulating competition. These were a few of its benefits. This year's Good Roads Show give a pretty clear indication that the highway industry has found itself.

A Progressing Improvement

JANUARY comes around so regularly and with it so inevitably comes the annual meeting of the American Society of Civil Engineers at New York that one is apt to forget how really distinctive that meeting is. At the Thursday night lecture this year the largest auditorium in the Engineering Societies Building, which holds around 900, had no visible empty seat and there were a number of men in the adjoining lobbies. And this year was rather below the average in attendance. Nowhere else do as many civil engineers get together. Here, if anywhere, should the will and thought of the profession become vocal. Here, too, should there be that public interchange of technical opinion which gains a force, by the actual presence of those who voice it and by the give-and-take of open discussion, superior in many ways to the more formal expression by written word.

It is an unfortunate fact that these advantages of the gathering together of so many distinguished and experienced engineers have never been fully realized and that of late, at least, the annual meetings, except in those recent years of acrimonious argument on society affairs, have been memorable mainly for the social intercourse. This intercourse is distinctly worth while. It promotes friendliness, increases acquaintanceship and disseminates technical opinion. But it is not enough. The annual meetings must have more than smokers and dinners and excursions if they are to justify their expense to the society and to its members who attend them.

This year the annual meeting moved nearer to the fulfillment of its possibilities, mainly because of the extension of the work of the technical divisions. The proceedings of the first day, outside of the presentation of honors and prizes which adds a commendable touch of dignity to what used to be mere formality, carried on the rather dreary traditions of the past. There were the necessary but dull reports of officers and the equally necessary and, it so happened, equally dull reports of the technical committees to take up the whole day. It would be difficult to impart much liveliness to the routine reports—though if they were in the hands of the members long before the meeting they might be passed over with mere reference except on special call from the floor—but certainly the technical committee reports lend themselves to more interesting treatment.

These technical committees are formed only because the subjects they cover are of especial and timely interest; otherwise they have no reason for being. They are not intended for routine consideration of routine technical matters. That being the case there are many members of the society greatly concerned with the subjects they are studying who, if properly selected beforehand, could contribute to a discussion of the work

of a committee in a way not only to aid the committee itself but also to inform the convention. All of the committees reporting would not require such discussion, nor would there be time for all of them, but the Board of Direction might well select from the committee reports submitted a few which promised active discussion and then, through the committee itself, arrange for a few discussors who being prepared would stimulate further discussion from the floor. The afternoon devoted to committee reports might thereby become something more than a four-hour anesthetic.

But to come back to the technical divisions. No member of the society could say that he could not find technical refreshment on Thursday. There was something doing every minute and most of it was worth while. Not only were the regular meeting hours utilized but the luncheon and dinner hours were also turned over to joint physical and mental recreation. The technical division idea is working out gradually but successfully, and nowhere is its benefit more evident than in the enlivening of the annual meeting of New York.

One other development of the meeting is worth noting; that is the informal organization of the representatives of the local sections. The government of the society must remain in its elected directors, but those directors, like the representatives of the people in the national Congress, must always be torn between the necessity of expressing the thought of their constituents and of expressing their own thought as one of a group of delegates. The society can be benefited by the views of the local sections, expressed directly through the delegate elected for that purpose and not to help govern the society. This function the house of delegates, to give the local section representatives a name, can fulfill. It can be a most useful advisory body, and one which will not overlap any of the duties of other parts of the society. The start toward its formation at the meeting is significant.

Comparative Studies of Imhoff Tanks

THE symposium on septic tanks presented before the Sanitary Engineering Division of the American Society of Civil Engineers on Jan. 17, although only a part of the program, would in itself have justified the meetings of the division this year. Factors of design, environment and operation at two Imhoff tank installations that have been eminently successful and at two others that have been the seats of considerable trouble were analyzed comparatively in a unique paper by Mr. Eddy, after which five other authors were scheduled for papers—one general and one by the engineer or operator of each of the four installations. After all this the subject was to have been thrown open to general discussion but although two of the scheduled authors were absent it was 6:20 p.m. when the authors present had finished. It is to be hoped that the other two formal papers will be obtained and put in type and the set of five papers then sent out to every engineer and city official versed in Imhoff tank design and operation in the United States and Canada and to representative men of experience in other countries. It is by such means that the Institution of Civil Engineers has built up several most valuable symposiums on sewage and water treatment within the past few decades.

A significant assertion made by Mr. Eddy deserves attention. Although he presented various comparative data of design, environment and operation he found himself compelled to declare that no comparative biological data for the four installations are available. Unfortunately this is only one of many cases that could be cited to show the scantiness or even the utter lack of data in many branches of engineering. The septic tank, of which the Imhoff tank is a variety or from which it was developed, as one pleases to put it, has been widely used for three decades. As an advance on sedimentation alone, the septic tank is essentially biological and yet we still lack comparative biological data, notwithstanding the wide use of one- and two-story septic tanks the world over and the thought and ingenuity put upon the engineering design of these structures.

Fortunately, biological data on the Imhoff tank are being accumulated and studied at the Plainfield Joint sewage-works by New Jersey state agencies and the sewage district, with the co-operation of the New Jersey Sewage Works Association and—from now on—of the Sanitary Engineering Division of the American Society of Civil Engineers. But however valuable the Plainfield data may be, they cannot be called comparative until similar work is entered upon elsewhere. May it be not long delayed.

Co-operation Well Started

LISTENING to the discussion regarding the standardization of equipment at Chicago last week in the meeting between manufacturers and the executive board of the Associated General Contractors, one could not help recall the situation which existed before the American Society for Testing Materials began to lay down specifications by which materials could be called for definitely. The contractors today are in the same quandary that the materials buyers were in then. What is a ¾-yd. shovel bucket? What a 21-ft. concrete mixer? a 10-ton crane, etc.? These sizes or performance capacities of construction equipment and its parts seem easier of specification than were the steel, non-ferrous alloys and clay products that the A.S.T.M. began to work on 25 years ago. Yet the problems are difficult and because of pride in their own practices manufacturers confess that they are unable, by themselves, to agree as to standards. They call upon the Associated General Contractors, as an impartial body, to decide between them and to lead. Again the A.S.T.M. history is repeated.

And may we not look for the same happy and fruitful results?

In association in the A.S.T.M., manufacturer and user of materials worked out standard specifications. The users did not ignore the experience of the manufacturers. In fact manufacturers were on every committee, but the users were always in the majority.

Why not now a similar plan for adopting standards of equipment capacities? Happily the first step was taken at Chicago last week. Patience will be required. Great results will not come soon. But with patience and earnest work good results will as surely flow in equipment standards under the A.G.C. as they did in specification writing under the A.S.T.M.

Nor will any manufacturer suffer. His ingenuity will not be curbed, but all his customers will know that the capacity of the tool he sells is that capacity as set by A.G.C. definition.

We hail the step as a distinct advance in determining the meaning of equipment ratings.

Davis Bridge Power Project to Develop 60,000 Hp.

New England Power System Unit to Produce 390,000,000 kw.-hr. Annually on the Deerfield River—In 70 Miles 1,700 Ft. of Head Are To Be Utilized—Major Unit Is 200-Ft. Earth Dam, Highest on Record

BY A. C. EATON
Hydraulic Engineer, Power Construction Co., Worcester, Mass.

PROBABLY the highest hydraulic fill dam in the world is approaching completion near Readsboro, in southern Vermont, as a unit of the Davis Bridge power development on the Deerfield River of the New England Power System. Besides this 200-ft. dam, the plans include a diversion tunnel to handle the river flow; a circular spillway located upstream from the dam discharging through a tunnel; an intake tower to control the flow to the power tunnel cutting off a big bend in the river and doubling the available head; a surge tank of unusual height because of the 90-ft. drawdown for storage use; penstocks with valve control at both the upper ends and at the wheel inlets, and a power house with ultimately three 20,000-hp. units and with low-tension equipment inside, a 110,000-volt transformer and switching station outside, and a 66,000-volt tie-in switching station adjacent.

The general layout of the project is shown in Fig. 1. This article will outline the design problems of the development and the detail of the structures; it will be followed by an article describing the construction of the record earth dam.

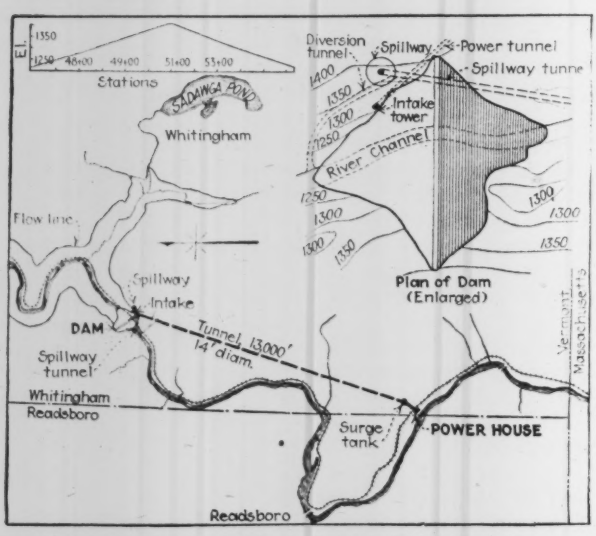

FIG. 1—DAVIS BRIDGE HYDRO-ELECTRIC PROJECT OF NEW ENGLAND POWER SYSTEM

This dam is the highest earth dam in the world built by the modified hydraulic fill method. The size and the speed with which it is being constructed make it one of the most interesting construction jobs under way at the present time. Cold weather prevented work from January 1 to April 15, 1923. The main dimensions are:

Height	200 ft.	Elevation of crest above sea level	1525 ft.
Width of base	1300 ft.	Volume in dam	1,900,000 cu.yd.
Width of crest	25 ft.	Area covered by dam	18 acres
Length of crest	1250 ft.		

Earth Dam Selected—At the dam, ledge outcrop is found adjacent to the stream on only one side of the river. Many well-drilled holes were driven over the site to determine the nature of the underlying material. At various depths, as these holes were driven, water tests were made to determine the tendency of the soil to take or make water. These tests indicate a very dense material. One hole at the edge of the river and about 100 ft. from ledge outcrop on the opposite side was driven 125 ft. without reaching ledge. This

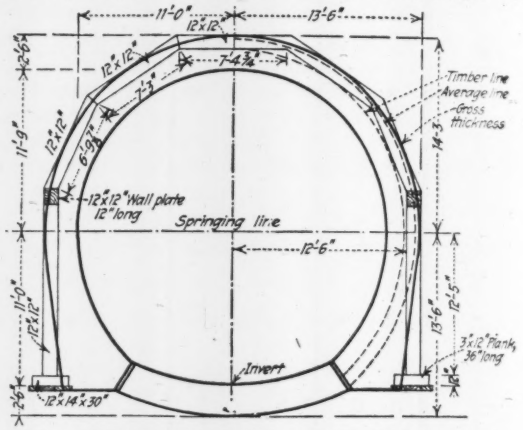

FIG. 2—DIVERSION TUNNEL IN EARTH SHOWING LINING AND TIMBERING

Timbering frames were set 4 ft. apart on centers and from 1 in. to 3 in. higher to allow for settlement. The lagging was 3 in. x 4 ft.

shows that the ledge drops off very fast and also that the stream is some height above the bottom of the rock gorge. With this fact in mind no consideration was given to a concrete design.

Preparation of the site required the removal of stumps from the total area; the complete removal of top soil from the middle third; the removal of the boulder layer in the middle third along the river bed and adjacent banks, and the excavation of a cutoff trench about 16 ft. deep and 50 ft. wide across the river bed and narrowing as it extended up the slopes.

Extensive investigations of available borrow material were made by means of well drills. At each test hole a large marker was placed showing the ground elevation and the elevation of ledge if reached or, if not, the elevation to which the hole was driven. These investigations covered a distance up and down river of two miles on both sides. The material, a glacial drift, carries an ideal mixture of boulders, stone and rock dust from which to build a hydraulic fill dam. Except for somewhat more extended deposits of gravel and sand, the material is typical of that used in the construction in 1912 of the Somerset Dam, which is located about 20 miles up the river, and which has proven most satisfactory. The table herewith shows the nature of the core material.

Stream Diversion Through Tunnel—One of the most difficult problems in the design of an earth dam is the stream flow during construction. The Deerfield River is very flashy and it seemed necessary to be conservative. A careful study was made of flood flow records of the river for the preceding 14 years. These records showed that while the usual period for floods was the spring yet

MECHANICAL ANALYSIS OF DAVIS BRIDGE DAM CORE MATERIAL

Size of Mesh			Per Cent by Weight Passing Sample 1	2	3
2 mesh sieve or	12.0	mm.			
4 mesh sieve or	4.71	mm.		100.	
6 mesh sieve or	3.50	mm.		99.2	100.0
10 mesh sieve or	2.02	mm.		98.8	99.8
20 mesh sieve or	.97	mm.	100.0	98.2	92.6
40 mesh sieve or	.44	mm.	99.6	97.2	78.2
60 mesh sieve or	.25	mm.	98.4	93.8	63.4
100 mesh sieve or	.15	mm.	97.0	87.0	50.4
150 mesh sieve or	.10	mm.	91.0	74.2	37.0
200 mesh sieve or	.07	mm.	82.0	65.2	31.0
mesh sieve or	.05	mm.	76.6	61.0	28.0
mesh sieve or	.04	mm.	46.5	39.2	16.8
	.022	mm.	29.3	22.9	9.4
	.012	mm.	21.5	18.5	8.1
	.008	mm.	17.6	12.4	4.6
	.006	mm.	15.7	10.2	3.5
	.004	mm.	14.5	9.1	3.0

Note—Sample 1 is taken from the center of the core. Sample 2 is composed of equal parts of material taken at center line, 30 ft. and 60 ft. upstream from the center line. Sample 3 is a composite sample taken from six different borrow pits with coarser particles screened out.

other periods of the year were subject to floods and that the maximum flood had occurred in July. This flood had a peak flow of about 135 sec.-ft. per square mile. The drainage area at the dam site is 154 sq.mi. exclusive of the 30 sq.mi. controlled by the Somerset Dam. To provide bypass capacity for the maximum flood and assuming a diversion dike sufficient to give 70 ft. of head on the diversion waterway, a conduit equivalent to a 22½-ft. diameter circle was required.

Another factor influencing the final decision to use this size was that the diversion had to pass through a spring breakup period, and while open-water conditions might warrant a somewhat smaller conduit, the danger of a possible plugging by ice and debris demanded a generous size.

The earlier studies contemplated the use of a reinforced-concrete conduit running under the dam but the more the problem was studied the less this plan was liked. There were too many unknown factors in the design of a conduit of this size such as the possible

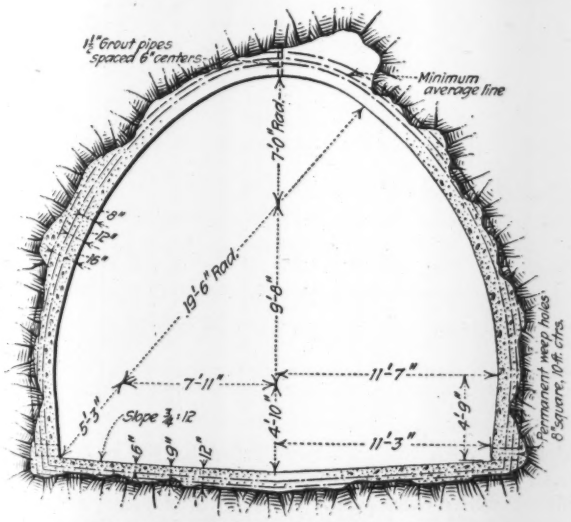

FIG. 3—DIVERSION TUNNEL IN ROCK

This thickness of lining was increased about 4 in. for portion upstream from the cutoff to be put in when the spillway is completed and ready for operation.

variation of the character of the earth foundation, the unknown loads to be carried, and the possibility of serious leakage along the concrete surfaces. The use of a conduit also meant a full year's delay in completing the project as the tunnel work could start in midwinter while the conduit construction would have taken the best part of the following summer season. The concrete conduit plan was therefore abandoned in favor of the tunnel.

Spillway Design Unusual—The valley at the dam site is narrow and a straight spillway of the required

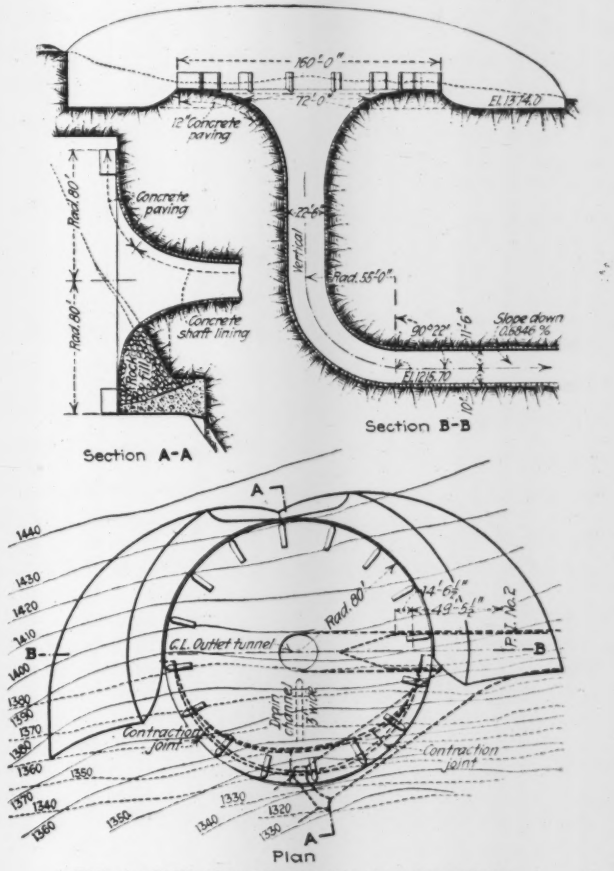

FIG. 4—DETAILS OF CIRCULAR SPILLWAY

capacity would have had to be perpendicular to the main dam. From it the water would discharge into a trough and be carried to a point below the dam through a channel extending along the side of the valley and down the slope. This design was abandoned because of the estimated cost, the uncertainty of probable capacity, and the fact that the diversion tunnel was already decided upon and a part of it could be used with a circular spillway.

The spillway as it is being built, Fig. 4, is 160 ft. in diameter and is symmetrical about a vertical axis. It resembles in shape a phonograph horn or morning-glory blossom gradually decreasing in diameter from 160 ft. at the crest to 22½-ft. at a point about 70 ft. below the top. The 22½-ft. shaft then extends down about 100 ft., at which point it takes a right-angle sweep and enters the lower end of the diversion tunnel on a tangent. Upon completion of the dam the diversion tunnel will be closed above the junction with the spillway shaft and the lower end of the big tunnel will then be a waste-way for the spillway.

The spillway will have around its circumference 16 radial concrete piers which serve the double purpose of carrying a bridge from which flashboards can be oper-

ated and of straightening the lines of flow as the water passes over the crest, thus reducing the agitation as the flow converges in the throat.

The spillway is located about 350 ft. upstream from the center line of the dam. It is so located that about

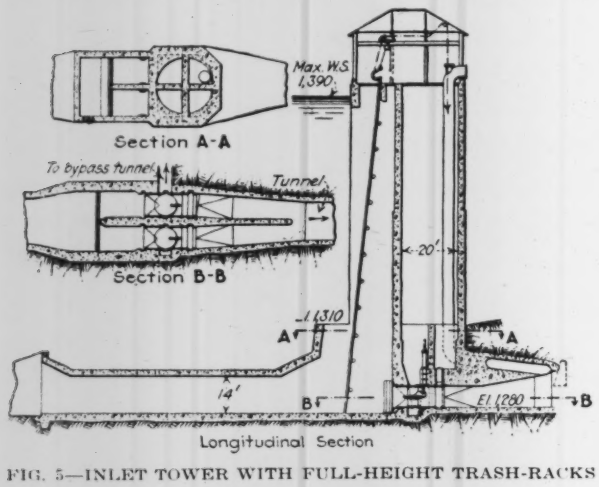

FIG. 5—INLET TOWER WITH FULL-HEIGHT TRASH-RACKS

one-half of the structure and the approach channels are excavated from solid ledge, while the downhill side of the structure is formed by a circular concrete dam resting on ledge, the whole forming a symmetrical structure at the top. The approach channels on the uphill side of the structure resemble a great double scroll with the point at the uphill side of the structure. These channels were proportioned to give a mean velocity of about 5 ft. per second with a maximum discharge of 7 ft. over the crest or about 30,000 sec.-ft.

This type of structure was proposed and the detail design was developed by the consulting engineers for the project, the J. G. White Engineering Corp. Because of the great importance of the structure, a model was made on a scale of 1 to 36 and tested in a flume constructed solely for the purpose at Whitingham near the site of the work. The results of these tests checked rather remarkably the computations of the design.

The capacity of the spillway is equivalent to about 200 sec.-ft. per square mile, which is far in excess of the peak of any known flood on the Deerfield River. In addition the reservoir has an area of 2,200 acres which would greatly flatten any flood peak.

Outlet Control Tower—The flow of water to the power tunnel will be controlled by valves located in a concrete tower, Fig. 5, about 300 ft. upstream from the dam. While the primary object of the tower is to form an entrance to the tunnel and to house the control valves, it is designed so as to make the valves accessible at all times and also to provide a fine trash-rack of generous area.

Inside, the main tower is 20 ft. in diameter and 115 ft. deep. This part will be dry. At the bottom are two 8-ft. valves of the disc-arm type operated by motors mounted directly above and supported by the valve housing. Below each valve in the downstream walls are cast-iron frames, which, with an entrance bulkhead provision, make possible the removal of either gate and operation through the remaining one, with only a temporary shutdown of the plant. A 4-ft. steel vent pipe extends from the tunnel back of the gates to the top of the tower. A small tunnel extends from the bottom of the circular chamber to the diversion tunnel below the closure plug. This takes care of any leakage and also provides access to the lower tunnel and small bypass gates.

To insure against any possible clogging the rack area is extended from the bottom to the top of the tower. These racks are 21 ft. wide between parallel walls extending upstream from the circular tower wall. The rack bars are 3 in. x $\frac{5}{8}$ in. spaced $2\frac{1}{2}$ in. c. to c. They are made up in sections and supported by 8-in. double, extra-heavy, wrought-iron pipe filled with concrete and spaced 9 ft. c. to c. There is a center nose behind the racks which gives the pipe supports a middle bearing.

From the bottom of the tower a 14-ft. square conduit extends about 100 ft. upstream. This conduit protects the lower approach to the tower from becoming clogged and permits of drawing down the reservoir to the desired minimum elevation.

The superstructure at the top of the tower will be 24x38 ft. and will house a traveling crane and a mechanical rack rake, and provide access to the tower proper. The approach will be made by a bridge extending from the near side of the spillway superstructure to the top of the tower.

Power Tunnel—The power tunnel is $2\frac{1}{2}$ miles long as compared with a distance of five miles along the river. It takes advantage of a 200-ft. drop between the dam and the power house and thus makes possible a head of 330 ft., with a full reservoir, and a minimum of 300 ft. with the maximum storage drawdown.

The tunnel is located in a mica schist formation of a fairly hard and very tough character. It is practically

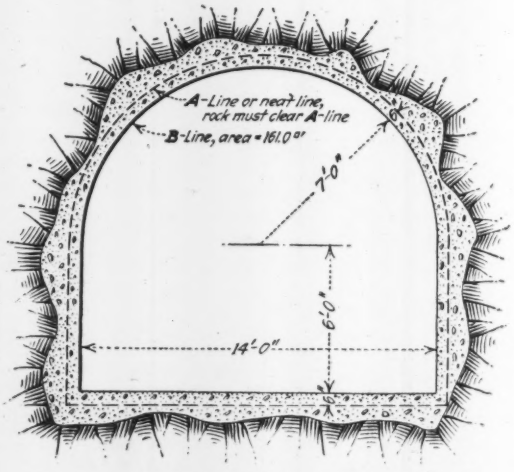

FIG. 6—STANDARD POWER-TUNNEL SECTION

identical with the rock penetrated by the unlined railroad tunnel between Hoosac Tunnel and North Adams, Mass., which was completed over fifty years ago. Because of the very satisfactory character of the rock, an unlined tunnel was considered, but computations and estimates indicated that for the quantity of water to be handled a lined tunnel of a smaller section was more economical than a large unlined tunnel. A thickness of lining of 6 in. was adopted as being the minimum that would be consistent with satisfactory placing.

The exact size of tunnel was determined only after alternative bids were received on 12-ft., 13-ft. and 14-ft.

tunnels. From these bids it was decided to use the 14-ft. size. The section used, Fig. 6, was fixed entirely from a construction standpoint, with a view to giving the maximum working width at the bottom for excavation operations and a semi-circular top to facilitate the placing of the top lining. The finished section has an

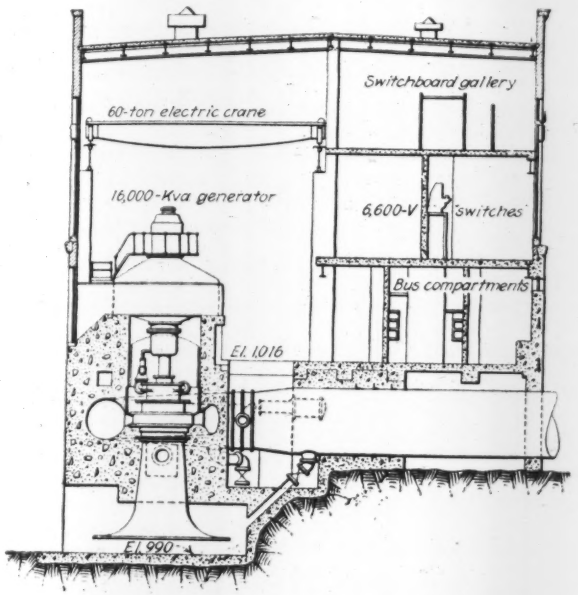

FIG. 7—TRANSVERSE SECTION OF POWER HOUSE

area of 161 sq.ft., which is hydraulically somewhat more than equivalent to a 14-ft. circular section of 154 sq.ft.

The elevation of the tunnel at the intake was determined by the maximum drawdown for storage. For the first 1,000 ft. a slope of 4 per cent was used to give the desired cover at a point when the tunnel crossed under a brook valley. For the remainder of the distance the slope is 0.1 per cent for drainage. This gives a maximum static head at the tunnel outlet of 155 ft. and a probable surge head of about 200 ft. With these facts in mind it was decided to use a plate steel lining capable of withstanding the bursting pressure for a distance of 320 ft. at the outlet end. The section for this distance is a 14-ft. circle. The lining is made of ½-in. steel plate, with concrete filling the space between the steel lining and the ledge.

Surge Tank and Penstocks—The surge tank is of the Johnson differential type with a diameter of 34 ft. and a height of 184 ft. The diameter of the internal riser is 8 ft. The maximum thickness of the ring plates is $1\frac{3}{32}$ in. and rivets up to a maximum diameter of 1½ in. are used. The tank has a bottom plate for watertightness. The bottom was completely assembled with the lower ring plate in an elevated position and then lowered to a 3-in. bed of dry sand and cement which in turn rested on a concrete base. As the tank will stand empty through the winter special care was taken with the anchorage design, which resulted in the use of fourteen 3-in. anchor bolts extending 14 ft. into the ledge.

It was first intended to have the tank directly over the outlet of the tunnel, but a closer study of the construction program showed the desirability of a location to one side. The center of the tank is 40 ft. to one side of the tunnel line and the bottom of the tank is 23 ft. above the center line of the tunnel.

The tunnel outlet is at an elevation 240 ft. above the river. At the outlet a shelf has been cut in the ledge which gives space for the interconnections between the tunnel, the surge tank and the penstocks. The 14-ft. tunnel lining is extended to permit the installation of a 10-ft. connection to the surge tank. The lining then merges into a three-branch manifold which in turn is connected to 8-ft. disc-arm valves located at the upper end of the 9-ft. penstocks. Specially designed 24-in. air valves are located at the top of the penstock to vent the pipes when the valves are closed.

The disc-arm valve was first developed for this installation by E. A. Dow, mechanical engineer of the company. It is a pivot type of valve with the operating arm directly connected to the lower part of the disc and operated by a stem extending through a stuffing box in the top of the valve housing and operated in this case by a motor drive mounted on top of the housing. The great advantage of this valve is in the connection to the bottom part of the disc, which gives a direct application of force on that part of the disc opposing the pressure of the water, thus resulting in a very tight closure. The valves are controlled from the switchboard in the power house.

Power House and Switching Stations—The power house, Fig. 7, has a concrete substructure located on ledge and a superstructure of steel and brick construction with cast-stone trimming. The uphill side has three floors; the ground floor section containing the low tension bus and a machine shop; the mezzanine floor, the low tension switches and a storeroom; and the gallery, the switchboard room, office, and the locker and wash room.

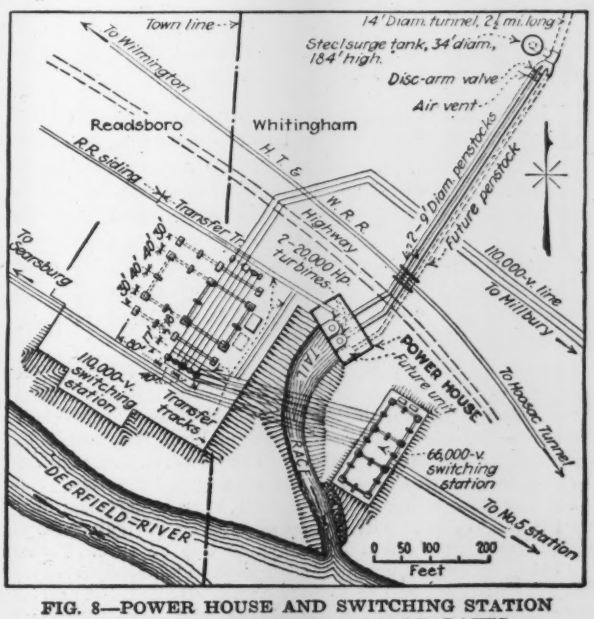

FIG. 8—POWER HOUSE AND SWITCHING STATION LAYOUT; TRANSMISSION LINE LEADOFFS

Downstream from the power house is located a 66,000-volt switching station about 180x60 ft., and upstream is located a 110,000-volt transformer and switching station about 220x150 ft. with provisions for future

extension. This layout, Fig. 8, interconnects the company's present 66,000-volt system and the new 110,000-volt line now being constructed from this point to Millbury, the center of distribution.

The two turbines now being installed are vertical, single-runner, Allis-Chalmers units with General Electric 6,600 volt, 16,000 kva. generators, and direct connected exciters, operating at 360 r.p.m. The turbines have a capacity of about 20,000 hp. under a mean head of 350 ft., with the point of best efficiency at about 80 per cent load. This point of best efficiency gives a water use for three units of about 1,400 sec.-ft. Great care was taken to obtain units with this water use at best efficiency as it was found that to materially exceed this water use decreases the overall efficiency of the plant by frictional loss through the long tunnel. During the process of developing the design for this installation the wheel manufacturers made and tested nine runners. The scroll cases are of plate steel construction completely embedded in concrete. Before concreting each case was tested and made tight at 260-lb. pressure. The cases were assembled and fitted in the shop, shipped knocked down, and reassembled and riveted in position.

Transmission Line—As noted above the new 110,000-volt line will extend from Readsboro to Millbury, a distance of 76 miles. There is a total of 580 towers from 50 to 70 ft. in height. The towers which are being furnished by the American Bridge Co. are designed to carry six 4/0 seven-strand copper conductors all in one horizontal plane. This requires a 60-ft. crossarm giving a conductor spacing of 12 ft. The insulators are made up of eight and nine units. There are also two $\frac{7}{16}$-in. seven-strand crucible-steel ground wires.

An average of about 200 men is employed in this work which requires the operation of six construction camps. The work was started January 1, 1923 and will be completed some time this year.

Studies Under Way on Filter Efficiency Limitations

THE U. S. Public Health Service has under way a detailed study of filter plants to determine just how far a supply can be polluted and still be made safe by subsequent purification. A small filter plant has been constructed at the stream pollution investigation station of the service at Cincinnati and a detailed survey of sixteen filter plants has been started. H. W. Streeter, sanitary engineer, U.S.P.H.S., indicated progress as follows at the recent conference of Ohio water purification operators:

Provision has been made at a 0.16-m.g.d. rapid filter for bringing to it a continuous supply of water from the Ohio River, sewage from a nearby intercepting sewer and clear water for dilution purposes, thus making it possible to deliver a raw water of almost any desired composition, varying from sewage to a highly diluted river water.

The program of experimental work to be undertaken during the coming year will consist of a series of "runs" varying in duration from a few days to two or three weeks, according to the requirements of a particular experiment. The examinations will be largely bacteriological, but special attention will be given to certain chemical and biological characteristics in connection with part of the work. After each "run" a thorough examination will be made of the plant, noting particularly the condition of the tanks and filters. Attention will be devoted to a number of special problems, of most immediate importance being a study of chlorination to be made in co-operation with the committee on chlorine control of the Conference of State Sanitary Engineers. This study will be directed specifically to a number of questions now raised concerning the efficiency and limitations of chlorine treatment as employed in connection with filtration processes.

In planning the survey of plants it was necessary to select one of two general methods: (1) A rapid and necessarily superficial survey of a large number of plants, designed primarily to give a general idea as to the extent and nature of the problems resulting from excessive pollution of raw water supplies throughout the country at large; (2) a more intensive study of a small group of plants, designed to give more detailed information concerning the effects of excessive raw water pollution upon the performance of each plant, and to furnish data from which a fairly complete statistical analysis might be made of the limitations in plant efficiencies as related to variations in the character of raw water. The latter method was finally adopted as offering a greater return for the limited funds available, and as being more directly concerned with the problem at hand.

At first it was intended to select a group of plants rather widely distributed geographically, but later it was decided to include a proportionately large sub-group comprising plants located directly on the Ohio River, selecting the remainder from plants situated mostly in the eastern states. This arrangement furnishes two rather distinct classes of material for study; one derived from a group of plants located on a common stream and therefore treating water which is practically the same physically but varies bacterially, the other from a group more widely scattered, each one representing a more or less distinct problem. An additional reason for including a series of Ohio River plants in the present survey has been the opportunity thus afforded of making a re-survey of conditions of pollution along this particular stream after an interval of nearly ten years, the Public Health Service having made an extensive laboratory survey of the Ohio in 1914.

The list of plants at which arrangements have been completed for collaborative study includes ten plants located directly on the Ohio River, beginning at East Liverpool, Ohio, and ending at Henderson, Ky., and six plants, located at Toledo, Ohio, Niagara Falls, Elmira and Albany, N. Y., Hackensack, N. J., and Chester, Pa. In connection with collaborative arrangements at Albany, plans have been made to include data from an additional plant, located at Waterford, N. Y., on the Hudson River above the point of entry of the Mohawk. An effort has been made to avoid the inclusion of plants having abnormal problems, and to include in the list at least one plant representing some particular type of problem.

Monthly reports are now being received from the sixteen plants included in the test group, and the data from each plant are being compiled progressively as the reports come in. Each report contains a summary of daily operation and laboratory results obtained throughout a given month, including results of B. coli tests at intermediate stages of purification. It is too early to undertake even a tentative statistical analysis of the results being obtained at the various plants, and no final analysis of them will be made until at least a year's results have been accumulated in each case.

Employees' Bonus Takes Novel Form

For each day's work performed during 1923 extra compensation at the rate of $1 a day will be paid during 1924 to all adult employees of the American Cast Iron Pipe Co., according to an announcement posted in the shops of the company at Birmingham. For boys the rate will be one-half that for adults. Payments will be made only to those who remain in the service of the company. The disbursements will be in 26 equal installments on other than regular pay-days. The minimum of extra compensation under this plan will be $156 (presumably to adults, with half that amount to boys).

Road Management, Materials and Construction

Road Builders in Convention at Chicago Discuss Outstanding Problems of Design, Traffic, Contract Practice, Surety Bonding and Simplified Practice

BREADTH of subject was particularly noticeable in the papers and discussions at the convention in Chicago Jan. 15-17, 1924, of the American Road Builders' Association. None of the papers was of local or regional interest alone. Each question considered was fundamental in road development wherever that development is in progress. Questions concerned the highway official of the county and township as directly as they concerned the national and state road official. This deviation in character from the specific and detailed discussion of practice and methods, which characterized the papers of the convention a year ago, rounds out a treatment of highway engineering and administration which, as given in the published proceedings of the Association, affords a fairly thorough treatise for road officials.

Separate abstracts of four of the papers read were published last week (*Engineering News-Record*, Jan. 17, p. 112) and others, too extended for a brief unillustrated review, will be published in succeeding issues. In the following review the papers are grouped according to their general subject matter and without regard to their order in the program.

Maintenance—Where there are large concentrations of paved road mileage the possibilities of central plant maintenance, instead of maintenance by a number of separate patrol units, calls for consideration. In Wayne County, Michigan, in which county Detroit is located, there are about 300 miles of concrete county roads in an area of twenty-five square miles. These are heavy traffic roads—the average for the whole mileage is nearly 2,000 vehicles daily. On some of them a 14-hour count runs as high as 15,000 vehicles. As described by Leroy C. Smith, engineer-manager, Board of Wayne County Road Commissioners, central plant maintenance of these roads is carried on from two yards located so as to keep the maximum haul to any road at about 15 miles. The yards are two or three acres in area and are on railways. Each has a 66x150-ft. garage, equipped with a boiler room, machine shop, forge shop, air compressor and gasoline storage space. There are on the railway tracks vertical cylindrical tar tanks holding 15,000 gal., or a tank car load, and provided with heating coils. They are charged by compressed air and are so mounted on concrete pedestals as to discharge by gravity into trailers. There is a 10-car cement storehouse. A crawler traction crane unloads aggregate, etc., from cars into elevated bins which chute into trucks. There is a 20,000-gal. buried gasoline tank. The provision for car-load purchase of tar gives a saving of 50 per cent and gasoline is obtained 5c. a gallon less than filling station prices.

From, or in, these yards all maintenance work is performed—repairs, roadside beautification, snow removal, painting center line, attending lights and signals and sign painting. The gangs register in and out at the yard as in a factory. As explained by Mr. Smith, the manner of doing repair work in detail is as follows:

Special trucks are used, ranging from two to four-ton capacity with divided bodies providing space for sand, pebbles, granite chips, and cold-patch mixed material. The two-ton trucks are being standardized upon pneumatic tires for speed and long mechanical life. In case of bituminous work, such as tarring shoulders or joints, the truck hauls a trailer, upon which is mounted a special tar tank having a capacity of from eight to ten barrels. This tank is equipped with kerosene burners and starts out with a hot tank-load of tar sufficient for the day's work for the gang. This equipment is in sharp contrast with the two-barrel kettle on steel wheels heated with staves from tar barrels while the gang sits by the roadside waiting for hot tar. Instead the tar is hot from the start and is kept hot by kerosene burners so that there is no loss of time in getting onto the job in the morning.

Gangs which are working upon concrete patching leave similarly from the central yard except that the heavy equipment, such as mixers and air compressor, is left on the job during the night. All broken or worn concrete is removed by jackhammers driven by compressed air furnished from a gasoline-driven air compressor mounted on a 5-ton trailer. This outfit is very easy to transport and can be moved from job to job as necessity warrants. Concrete mixers for patching are also mounted on trailers as it has been found they are more easily moved from job to job and the expense of loading and unloading is eliminated.

Many small depressions can best be repaired by the use of cold-patch bituminous material. The aggregates and bituminous material for this purpose are assembled at the central yard, mixed in a permanently located concrete mixer and allowed to season in a stock pile, from which the material is loaded on trucks for the various roads where the gangs tamp it into any small depressions and holes in the road.

The efficiency of the centralized maintenance organization in Wayne County is reflected in the fact that expenditures during 1923 exceeded those of the previous year by only 2½ per cent while the mileage of road maintained increased about 18 per cent.

Snow Removal—Another maintenance problem is to keep highways open in winter. Snow removal is an essential part of central plant maintenance described by Mr. Smith, but a far more comprehensive operation was that described by E. E. Reed, assistant state highway engineer of New Jersey, as carried out on the main highways of his state. All the state system of 726 miles is kept open in winter. The actual snow handling is done by field forces subdivided into the contractors' forces, state highway maintenance forces and state highway equipment forces. The state highways are divided into sections approximately 12 miles in length. For this year there are 59 such sections, 47 of which are assigned to contractors and 12 are handled by maintenance forces. A map is prepared showing the sections which are to be opened by contractors' forces and maintenance forces, and name of each contractor appearing on these sections. A questionnaire is prepared and forwarded to each contractor. He returns this questionnaire giving the correct name of the contractor, the name of his superintendent, and the telephone numbers of the garage where the trucks are stored and where his representatives may be reached at any time of the day or night, Sundays or holidays. A chart is made of this information for ready reference.

The equipment used on the contractors' sections consists of trucks used by the maintenance forces for repair and maintenance work. When this work is completed they are sent to the Fernwood service station, which is a large garage and machine shop located near Trenton where they are thoroughly overhauled and put in good condition for snow-removal work. The scraper blades or snow plows are attached and the trucks are forwarded to selected garages located at points convenient to the different sections.

There are three trucks assigned to each section. The equipment is kept in heated storage, with the snow plows attached, and the trucks are filled with ballast and jacked up to relieve the springs. The contractor is required to have three men on each truck, two drivers and one helper. This is necessary because when they start out in a storm, it may be necessary to be out 16 or 24 hours and this is entirely too long a shift for one man to serve without relief. With three men on the truck there is always relief available without holding up the equipment for one of the crew. The contractor has a superintendent in charge and the men he employs are usually the men that he keeps during the winter in order to hold his organization together.

The 12 sections handled by maintenance forces are generally gravel roads that have not yet been reconstructed and the equipment which is used for gravel maintenance work is used for snow removal purposes. This consists of a 3 or 5-ton crawler tractor and one or two scrapers.

In addition to the contractor's forces the maintenance division assigns one of its foremen to each section to assist the contractor and co-operate with him. He also keeps in touch by telephone with the Trenton office and advises it of the progress being made by the field forces. The equipment division also assigns a mechanic to each of the contractors' sections and maintenance division sections to see that the equipment is kept in proper working order and to make any adjustments or repairs.

This entire organization is handled from the Trenton office. If the information received from the U. S. Weather Bureau is of a definite nature, a snow call is issued. If no information is obtained from the Weather Bureau in advance of a snow storm, field representatives keep in touch with headquarters if it begins snowing. If it is apparent that the snow will result in a fall of 2 in. or more, a snow call is issued and the contractor is notified to call his organization together at the garage where the trucks are stored for his section.

A record is made in the Trenton office of the time of this call. The contractor then calls back when his organization is together but he is not authorized to go out on the road until the office is satisfied that the snow is of such a depth as to warrant removal.

The three trucks travel together up one side of the road in echelon pushing the snow out to the side as far as possible. A trip is made to the end of the section and then a return trip is made on the other half of the road in the same manner. The purpose is to push the snow back far enough so that subsequent snows will not restrict traffic to less than a two-way opening.

It is absolutely necessary, Mr. Reed explained, to call out the organization and have it ready so that the snow can be removed when approximately 2 in. in depth and have the outfits continue removing the snow throughout the storm.

When the outfits have cleared the road, a representative calls the Trenton office and reports this fact. He is then authorized to disband his forces, or if another storm is imminent he is told to hold his forces in readiness. When an outfit is finally called off, a record is made in the office so that when bills are presented they can be checked with this record. A contractor presents his bills for snow removal work after each storm.

This work done by the contractors is not done by contract but by force account and the rates paid are previously agreed to by the highway department and the contractors. The bills for the monthly storage for the trucks, which range from $10 to $20 per month per truck, are paid directly by the state highway department to the garage owner. No hand shovellers are permitted without first having the request O.K.'d by the Trenton office and these are only used in cases of emergency where blizzards are encountered. Maintenance forces open the drainage ditches and structures as part of their regular duties after the road is opened.

In addition to the equipment mentioned there are for general emergency purposes six 10-ton crawler tractors equipped with V-type locomotive plows stationed at certain strategic points throughout the state.

During the winter of 1922-23 snow fell on 44 different occasions. On 16 of these occasions it was necessary to do snow removal work. Twenty-two or just one-half were recorded as traces, that is less than 0.1 in. fell and snow removal work was not necessary. The snow calls issued during the various months were as follows: November, none; December, two; January, nine; February, four, and March, one; making a total of 16.

The depth of snowfall varied in different parts of the state. In the northern part the total snowfall was 61 in. The least snowfall recorded was 15.7 in. at Sandy Hook. The average total for the state was 44.7 in.

The length of the state highways under snow removal during the winter of 1922-1923 was 698 miles. The total cost of this work was $223,908.76. The average cost per mile was $321 and the average cost per inch per mile was approximately $7.

Construction—Outstanding construction problems and developments were outlined in three papers, one of which on methods of sand-asphalt road construction by E. R. Olbrich, of the National Research Council, was given in condensed form in *Engineering News-Record*, Jan. 17, p. 114. The second paper, on accelerated methods of curing concrete roads, by H. F. Clemmer, engineer of materials, Illinois Division of Highways, will be given separate space in a succeeding issue. Controlling the distant units in a highway construction organization was the subject of a third important discussion by O. M. Kipp, construction engineer, Minnesota Highway Department.

Control of engineering units supervising highway construction is a vital question to the contractors bidding on work in Minnesota, Mr. Kipp asserted, for, if control is not exercised adequately by the state department, the cost of the completed work may depend in a large degree on the individual engineer in immediate charge of the work and upon the attitude of the county board awarding the contract. An additional hazard has therefore been introduced, which the contractor must take into account and which results in higher unit prices. Mr. Kipp explained construction procedure as follows:

There are two systems of state highway department control over construction work: State supervision over contracts let by counties; and construction contracted and supervised directly by the state department.

In the early history of most highway departments, construction was performed under the first system. While its advantages over individual unrelated effort by the several counties are many, yet control of the construction is limited by the attitude of the county boards who award the contracts and make final settlement with the contractor. Under this system it has been the practice also for the engineer in charge of the work to be employed by the contracting county and the control of the contract is therefore further limited by the ability and attitude of the county highway engineer. Uniform procedure as to location, design and supervision of construction, or uniform treatment of contractors cannot be fully obtained under this system. In spite of standard specifications and requirements as to plans, in spite of uniform laws, rules and regulations, the

characteristics of the boards awarding the contracts and of the engineer under their employ are reflected in the completed construction, the treatment of the contractor and the cost of the work.

There is a decided improvement in the results obtained under the system where the engineers supervising the work for the counties are employed directly by the state department. When such engineers are in the employ of the state they seem to grasp the point of view of the state department more readily and more completely. They are thus able to bring the action and attitude of the county boards into more uniform alignment with the policy of the state department.

With the growth of highway construction by the states there has been a tendency towards the substitution, at least for the primary or trunk highways, of the second system of control, namely, construction contracted and supervised directly by the state department.

State Purchase of Materials—Where large construction programs are in process of development the road-building materials supply has become a critical task. State manufacture and state purchase are both being considered. In two papers the merits of these plans were constructed. B. H. Piepmeier, state highway engineer of Missouri, presented the problem and its solution as they were determined in his state. Part of Mr. Piepmeier's discussion follows:

On account of the large road-building programs which many states have and which they will continue to have, many highway departments have been led to direct their attention to the problems of acquiring cement and other road-building materials. The seemingly high prices of materials, the difficulty in getting shipments promptly, and the regulations requiring contractors to pay local dealers a commission on shipments made direct from the mills to the consumer, have stimulated the Missouri State Highway Commission to seek a solution of the problem.

If the state highway commission feels that it must lower the item of cement cost in its building program, what course can it pursue? The solution is the problem that confronts the state departments. The commission must first satisfy itself that cement prices to its contractors or to the state are too high. If they are found to be out of line with what it feels it should pay, its procedure is to manufacture its own materials or to make some other arrangements that will accomplish the results desired. On account of the limited supply of cement which Missouri will need each year of its road-building program it did not attempt to build a plant but arranged with a private stock holder of one of the up-to-date plants, which furnishes cement for a large part of the state, to transfer a portion of the cement company's stock over to the Missouri State Highway Commission, as trustees, thereby enabling the department to acquire a large portion of its cement at actual cost. The plant equipment and manufacturing costs were examined very carefully, and the economy of the proposition was thoroughly determined before the contract was actually closed. In many states the volume of cement needed each year would prohibit a similar scheme, as the supply could hardly be furnished from any one plant.

The question of cement is not the most serious material problem. In Missouri the cement problem is rather small compared with the problem of acquiring sand, gravel and stone in suitable quantities and of satisfactory quality and price. The factors of price, quality and adequate supply of materials are very essential in a large road-building program and must be seriously considered by all state departments if their program is to continue uninterrupted.

The matter of price has been fixed chiefly by the extent of the demand. Small plants, in most cases poorly located and designed, are not conducive to efficient operation and naturally their prices must be above normal. With a rapidly increasing construction program, the demand far exceeds the supply, and the output of the small plants is readily absorbed. Hence, there is a tendency on the part of the producers to raise the price above normal as their outputs will be consumed regardless of the price asked. The prevailing prices in Missouri during the 1923 construction season were as follows:

Crushed stone.....	$1.92 per cubic yard at plant	(Demand exceeded supply)
Concrete gravel...	1.10 per cubic yard at plant	(Demand exceeded supply)
Sand.....	1.02 per cubic yard at plant	(Supply equal to demand)
Cement.....	2.00 per barrel at plant.....	.....

It is evident from the prices quoted above that something should be done to control the price as well as the quantity and quality of material. Missouri has, during the past few months, purchased gravel and sand deposits, and stone quarry sites, and has acquired an interest in an up-to-date cement plant. By our wholesale purchase of material, we estimate that we have already saved the state $3,000,000 in our road-building program.

North Carolina's Experience—In North Carolina, it was stated by C. N. Connor, construction engineer, State Highway Commission, that state purchase of materials has been satisfactory. Mr. Connor said:

In marketing portland cement the general practice is to sell the product to the consumer through dealers, and when a dealer does an actual service he is entitled to a fair and just profit. The dealer does a real service by using his yards as a small storage supply base and many times in assuming the consumer's credit obligations until such time as the consumer chooses to pay for the product. In public works, however, this reasoning does not seem to hold. On road contracts very little of the cement purchased through dealers goes through the dealer's yards. It would seem desirable, therefore, that the states, as large consumers of cement, should be entitled to more consideration from the manufacturers and that cement used for state work should be bought at a price no greater than that paid by dealers.

Using public moneys to develop industrial enteprises means competition with private corporations and this is a dangerous undertaking, and should be considered only after exhaustive investigations and conferences have been held, and even then with extreme precaution.

Investigations and reports seem to point to the inadvisability of the state owning and operating its cement plant. A government-owned plant of any kind cannot be operated as efficiently as a privately-owned plant.

Whether or not cement profits accruing to the various producers are reasonable, is for the United States Government to decide, but Professor Willis of Columbia University has announced that "It would appear that whether received as a return upon business turnover or upon the value of output; or whether received as a return upon actual investment, the earnings of representative cement producers during the year 1922 have been well below the average obtained by industrial undertakings at large."

Possibly in view of the foregoing conclusions, but undoubtedly on account of the determination to secure a steady supply of this important material as well as to avoid the disastrous delays and to increase the rate of progress on road work, several of the states are furnishing their contractors with cement without state manufacture.

North Carolina has been furnishing cement on a large scale since the spring of 1921. At first there were some complaints from local jobbers, due to the fact that they were unable to collect any brokerage. There have been some few delays in the delivery of cement but these delays were not as numerous as when the cement companies had been furnishing the contractors direct.

Up to the present time, which covers a period not much in excess of two years, the state has saved approximately $350,000 over the old methods in which the contractor secured cement from the companies or local jobbers. This saving has been brought about from the fact that in probably 90 per cent of the cases, the contractors would not have been able to take advantage of the discount. When the contractor does not take advantage of the discount the state pays for the cement direct and gets the discount. The price of the cement as used is deducted from the current estimate. The saving is further effected by the state charging from 3 to 15 per cent brokerage for financing the transaction.

Through-Truss Spans Converted to Deck Girder Viaduct

Without Halting Traffic Chicago Elevated Railroad Places Columns and Girders to Carry Floor of Two Truss Spans Over Union Station—Four Large Derricks Handle New Steel and Old Trusses

CONVERTING two four-track truss spans into a plate-girder viaduct, and performing this operation without interrupting heavy railway traffic upon and under the structure, under many complicating difficulties, was successfully carried out recently on the Metropolitan West Side Elevated Ry., Chicago.

These two spans, 210 ft. and 196 ft. c. to c. of end pins, formed the west approach to the bascule bridge crossing the Chicago River and carried the elevated railroad over the south end of the Union Station. The adjacent ends of the spans were carried by two stone piers, one for each pair of bridge seats, and it was necessary to remove these piers as they obstructed the track and platform layout of the new Union Station. These piers were on a skew with the bridge, owing to the existence of surface structures at the time the bridge was built, so that in the longer span the south truss was 210 ft. and the other 234 ft. long. Steel columns or bents could not be placed as substitutes for the piers. In fact, such construction would not have given sufficient longitudinal stability, especially as the outer end of each truss span was carried by a steel bent, one of these being a rocker bent to provide for expansion and contraction movements. The general situation at the bridge is shown in Fig. 1. To meet these conditions it was decided to convert the truss bridge into a viaduct, supporting its deck by columns from below instead of suspending it from the trusses. The viaduct columns are located in the center lines of the future station platforms and are seated on grillage supports on concrete piers sunk to hardpan. Between the columns are framed 54½-in. longitudinal plate girders just below the bottom chords of the old trusses. The old floorbeams are framed to the web of these girders by suitable connections, the stringers and solid deck remaining unaltered, except for necessary changes at the skew ends on the old masonry piers. After the structure had been converted in this way the old trusses were taken down. The viaduct spans range from 39 ft. 3 in. to 63 ft. 6 in. long.

Alterations to Bridge—At the west end of the structure a rocker bent supporting the trusses had to be removed and new stringers framed between the last floorbeam of the viaduct and the end floorbeam of the girder span crossing Canal St. At the old skew connection of the truss spans, the removal of the masonry piers and diagonal floorbeam between them required inserting a new floorbeam square to the bridge and new stringers to complete the deck framing. New cross frames and rearrangement of lateral diagonal bracing were required also at two points. At the east end, the girders are flared beyond the lines of the old trusses and are carried on the ends of a new bent of special construction.

In the completed work the viaduct columns will be in the middle of the station platforms and the trainshed roof will be close under the longitudinal girders, as shown in Fig. 3. The roof framing will be carried by columns alongside but independent of the viaduct columns.

Steel Details—Since the column spacing for the new viaduct had to conform to the platform spacing of the station it could not be adapted to the panel points of the trusses. At the top of each bent the two columns are connected by a pair of latticed struts under the floor (Fig. 3). The columns, being quite long, 36 ft., are of heavy construction, with an H-section having the web parallel with the center line of bridge. The average column is composed of a web plate, 17x1 in., four interior angles 6x6x1 in., four cover plates 20x⅞ in., and four outer angles 6x3½x1 in. with batten plates across the open sides. The longitudinal girders are framed against the cover plates of the column; these connections are on the skew, as the columns are placed square with the station platforms while the line of the viaduct is at a slight angle. Each column is seated on steel grillage on a concrete foundation pier, the same grillage also supporting the columns which carry the trainshed roof. The longitudinal girders are 54½ in. deep over flange angles and have 18-in. cover plates. At expansion joints the upper part of the girder is extended to rest on a seat carried by a bracket on the face of the column. At fixed points, the girders are seated on brackets and framed between deep connection angles on the faces of the columns.

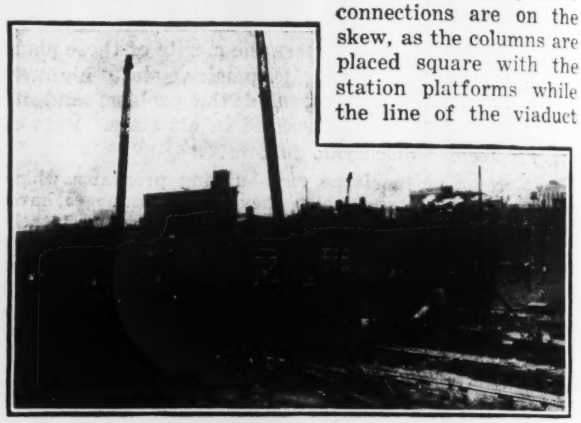

FIG. 1—CONVERTING TRUSS SPANS INTO A VIADUCT: CHICAGO ELEVATED RY.

Columns and girders support deck of old 210-ft. truss span between the two sets of derricks. The four big derricks have removed the old through trusses. Second truss span to be removed. Canal St. at left, passing under girder span of elevated railway. Union Station tracks and platforms under construction on lower level. Bascule bridge beyond truss span crosses Chicago River.

Leakage through the crack between trainsned roof and viaduct columns will be prevented by a horizontal shield 62 in. square near the top of each column, just above the roof level, shedding rainwater clear of the roof opening.

Special End Bent—Alterations are to be made along the river bank when the bascule bridge is rebuilt for a wider channel, as required by the U. S. War Department. This bridge, built in 1895, was the first of the Scherzer rolling-lift bascule type, and consists of two parallel double-track spans normally operating as one structure but capable of being disconnected in case of accident to or on one side of the bridge. At present there is a 108-ft. channel supplemented by a covered

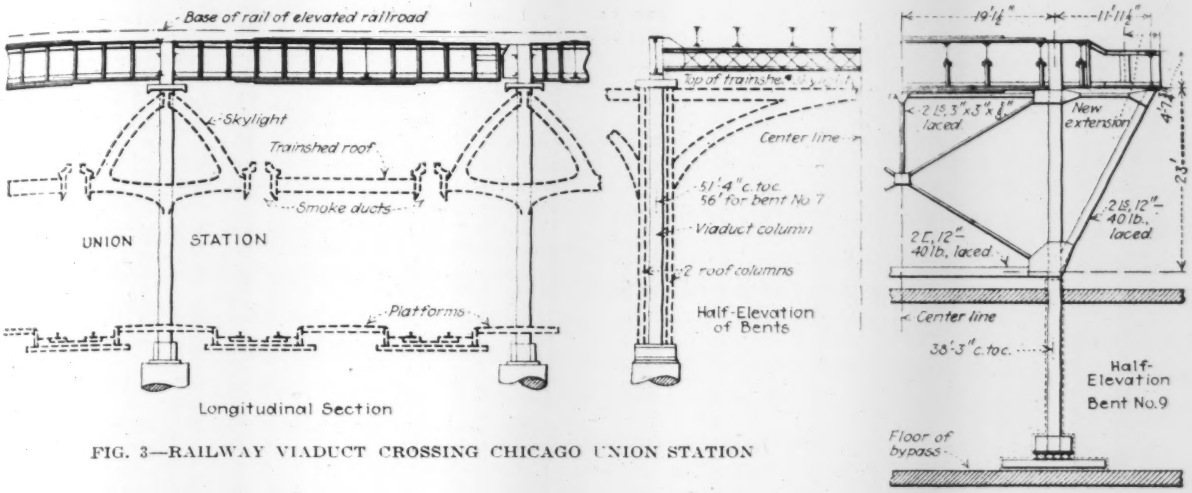

FIG. 3—RAILWAY VIADUCT CROSSING CHICAGO UNION STATION

bypass 50 ft. wide in rear of the west pier of the bridge. With the river channel widened to 200 ft. this bypass will be filled and tracks laid.

As the permanent location of the east end bent of the viaduct could not be fixed under these conditions, a temporary foundation was built. It is located in the bypass and consists of steel grillage on a broad concrete slab placed by a diver after the removal of the soft soil at the bottom of the bypass channel.

At this bent the elevated tracks are spread to conform to the spacing on the bridge (which has two center trusses, as noted above); the floorbeam therefore had to be longer than normal, while surface conditions made the column spacing even less than normal (38 ft. 3 in. c. to c. instead of 50 ft. as in the other bents). The old floorbeam was lengthened by splicing on extensions to carry the longitudinal girders about 12 ft. beyond the columns; this overhang being too great to act as a cantilever, the ends of the floorbeam are supported by raking struts, having their feet riveted to the columns at the ground level and having their heads held by horizontal ties from the tops of the columns, as shown.

Placing New Steel Work—In the reconstruction, falsework was necessary to provide for supporting the bridge deck when the floorbeams were cut loose from the trusses. For this purpose, two adjacent panels of floor were supported by three timber bents 30 ft. high carrying eight lines of timber stringers which were wedged up against the three floorbeams. This falsework was noteworthy for the use of large sticks of Douglas fir, the stringers being 20 in. square and in 24-ft. lengths. These bents were handled as units by the derricks, being shifted as the work progressed.

Placing the new material for the viaduct was complicated by constant movement of trains, passengers, and baggage and mail trucks beneath the structure, and also by the construction work for the new station tracks and platform. Beginning at the west end of the longer truss span, the first column and girders were placed by locomotive cranes on the station tracks. But these cranes could not be used further, owing to interference with traffic. Therefore, four steel stiff-leg derricks were erected, two on each side, those at the west end being on the Canal St. sidewalk and those at the east end of the span being on temporarily vacant spaces at the level of the station tracks. Each derrick had a 110-ft. boom and 36-ft. mast, with a hoisting capacity of 15 tons at 90 ft. reach.

While erection of the new steel was complicated by the traffic in the station below, dismantling of the trusses was further complicated by the fact that elevated trains on the four tracks of the bridge were passing at intervals of a few seconds. Flagmen on the

FIG. 2—PLACING VIADUCT BENTS UNDER TRUSS SPAN
New column and cross strut in place to carry longitudinal girders framed against old floor beams. Truss span supported on falsework.

structure stopped trains occasionally during some critical move, but otherwise there was no interference with this incessant traffic. These traffic conditions also made it necessary to remove both trusses simultaneously, since it was impracticable to shore up one truss when cut loose from the other. The removal was accomplished therefore in complete bays or panels. The web members on both sides of the bay were first cut loose at each end by torches, being attached to the hoist line of a derrick, so that as soon as they were free they swung

out and lowered into a car on one of the station tracks below. Each truss post was blocked up and tied laterally on the new longitudinal girders, which were made heavy enough to support this additional load when the trusses were cut in two.

The eyebars of the two bottom chords were next cut and handled in the same way. Then the overhead cross-frames between the posts and the longitudinal struts between these frames had to be cut away and removed. The next step was to cut and lift out a section of each top chord. Finally, the posts were cut away above the bottom chord pins and swung clear, the end of the top chord in the next panel being supported by a timber post on the deck steel. These operations are indicated by the view in Fig. 1, in which the removal of the first truss span has just been completed by the four derricks which are shown in position. The two derricks at each end of the span covered the entire work on the span. In the parts near the middle, which required a long reach, attachments were made to the falls of both derricks, thus distributing the load. In this way the parts were lowered into cars on the station tracks.

Engineers and Contractors—Work on the 210-ft. span was commenced May 17; the columns, girders and new floor connections were completed by July 26; removal of the trusses was commenced July 30 and completed Aug. 4. A crew of about twenty men worked 8 to 12 hours daily, this crew including the erectors, torch men and helpers. Structural design and the planning and execution of the work were all under the direction of C. M. Mock, chief engineer of the Metropolitan West Side Elevated Ry. The work was done by the Overland Construction Co., Chicago, under the supervision of F. J. McCain, president of the company. Steel was furnished at a pound price by the American Bridge Co., and the contract for the entire erection was placed at a lump sum price.

Creamery Waste Purification by Means of Activated Sludge

DISPOSAL of creamery wastes by the activated-sludge method has proved satisfactory in laboratory experiments at Iowa State College, Ames, Iowa, made by Dr. Max Levine. Ordinary digestion of creamery wastes develops so much acid that the regular regime of a septic or Imhoff tank is entirely upset if the creamery volume is at all a considerable portion of the sewage. The right kind of digesting bacteria cannot grow on acid media; they thrive in a slightly alkaline medium. The Ames experiments reported recently at the fifth conference of Iowa sewage plant operators by Dr. Levine were directed toward an oxidation of the milk sugars by long-time aeration, thus forming CO_2 and water rather than lactic and other inhibiting milk acids. From a bulletin on the subject the following abstract is taken:

Observations were made on the effect of aeration of various concentrations of skim milk and of butter-milk with respect to changes in oxygen requirement, nitrogenous matter, turbidity, relative stability and removal of solid constituents. Aeration was carried out first in bottles in which about 5 liters of material could be treated and later in a barrel in which 32 gal. were employed. The air was not measured in the bottle experiments where it is estimated that 60 to 75 cu.ft. per gallon was supplied in the 19- to 24-hour aeration periods. In the barrel experiments about 25 per cent less air (50 to 60 cu.ft. per gallon) was used for the same aeration period.

An activated sludge may be developed in about two weeks from 2 per cent skim milk. Aeration of 2 per cent skim milk for 16 to 25 hours in bottles or in barrels (with 20 per cent activated sludge and 50 to 60 cu.ft. of air per gallon) effected marked reductions in turbidity, acidity, total solids, organic nitrogen and, particularly, oxygen consumed and demand. Reductions of 95 to 98 per cent in the oxygen requirements were generally obtained. Activated-sludge treatment was more effective with 2 per cent butter-milk than with skim milk.

With separately, partially aerated sludge, employing an aeration period of 6 hours and 15.6 cu.ft. of air per gallon, there was an average reduction of 43.9 per cent solids, 77.7 per cent organic nitrogen, and 76 per cent oxygen consumed and demand. Reducing the air supply to 11.4 cu.ft. per gallon and increasing the aeration period to 12 hours resulted in about 20 per cent greater reductions.

Elimination of 95 per cent of the oxygen requiring constituents from 2 per cent skim or butter-milk is not sufficient to yield stable effluents. Possibly better distribution of air together with mechanical agitation may give more stable effluents.

A creamery waste differs markedly from ordinary sewage in many respects but particularly in that it contains the carbohydrate lactose which rapidly undergoes acid fermentation, thereby rendering the waste extremely refractory to septic tank treatment.

The acid-producing constituents can be eliminated by direct oxidation. Four hours' aeration of 2 or even 3 per cent skim milk with activated sludge was found to be sufficient to yield effluents which would not become appreciably acid on storage under anaerobic conditions, and which would therefore probably not be objectionable for admixture with municipal sewage in septic tanks.

Wilmington Completes One Unit of Port Development

Modern Marine Terminal With Combined Railroad Car and Truck Loading Facilities—Covered and Open Storage

BY CHARLES H. GANT
Manager Board of Harbor Commissioners, Wilmington, Del.

THE GENERAL plan of development at Wilmington, Del., of which the terminal, just completed, is the first unit, contemplates the utilization of the south bank of the Christiana River at its junction with the Delaware and the Delaware shore from the mouth of the Christiana to Pigeon Point Pier of the Philadelphia & Reading Ry., about a mile downstream. This location lends itself admirably to the scheme of development proposed, namely, a quay wall on the Christiana and re-entrant piers on the Delaware.

The plan just carried into effect involves a quay wall 1,210 ft. in length; a transit shed, 400 ft. long by 120 ft. wide; two storage sheds, each 500 ft. long by 120 ft. wide; a coastwise cargo shed, 200 ft. long by 20 ft. wide; an open storage yard with a bulkhead frontage of 400 ft. and an area of about 7 acres; a railroad yard with a capacity of 70 cars, concrete roads, fire and domestic water lines, etc. The construction is modern and permanent in character throughout.

Quay Wall Construction—The bulkhead or quay wall is of timber pile and reinforced-concrete construction. The piles are driven in double bents, 10 ft. c. to c. and cut off at an elevation of 3.25 ft. above the m.l.w. datum. Upon these piles are reinforced-concrete beams with the piles embedded 9 in. in the concrete. A series of arches, piers, and columns are carried from these beams to support a concrete slab which comprises the deck of the wharf. The elevation of this deck is 12 ft.

above m.l.w. At the rear of the bulkhead platform is a row of timber sheetpiling 12x13 in. extending from the level of the lower concrete down into the river bottom, and under the platform a heavy bank of riprap stone acts as a revetment and also adds to the stability of the structure. Three rows of spur piles with their heads likewise embedded in the concrete are also provided to resist the thrust of the fill in the rear, which consists of a cinder bank immediately adjacent to the sheetpiling and of selected earth fill from the cinder fill to the old river bank about 100 ft. inshore. At each pile bent there is a tie-back to a cluster of three piles, 60 ft. inshore; one vertical and two spur piles forming the anchorage, while the tie rods are of 2-in. diam. wrought iron.

On the surface of the concrete platform there is a standard-gage track and a track for a full portal gantry crane as well as bollards, mooring posts, cleats, etc. The face of the bulkhead is protected by a timber fender system against the chafing of vessels lying alongside.

The pile penetration varies from 45 ft. below m.l.w. at the upstream end to 65 ft. below m.l.w. at the downstream end.

Structures—The transit shed is one story of steel and brick construction with a slow-burning construction roof. The front line of columns spaced 20 ft. on centers is carried by the bulkhead while the rear center lines are carried on pile clusters driven to refusal. The trusses supporting the roof are 120 ft. long supported in the center. Along the bulkhead front is a continuous line of double-leaf link-suspended doors. The floor when laid will be of reinforced concrete, but this work has been delayed in the shed to allow the fill to settle.

Extending above the roof along the waterfront side of the shed, to a height of 70 ft. is a system of columns and beams for cargo-handling purposes.

Two storage sheds each 500 ft. long by 120 ft. wide similar in plan and construction to the transit shed extend inland perpendicular to this shed. On either side of these buildings and along the rear of the transit shed are platforms 20 ft. in width covered by a canopy. Between these two wing sheds are four depressed railroad tracks, while on the outside of each wing is a 40 ft. concrete roadway, also depressed. In the rear of each wing, one bay, 20 ft. in width, has been set aside for offices. In alternate panels alongside these sheds are single-leaf link-suspended doors.

The coastwise cargo shed at the upstream end of the wharf is of the same type of construction as the transit shed, although on a much smaller scale. Its shorter dimension is parallel to the wharf and on one side is a depressed concrete roadway and on the other a depressed railroad track. A wharf drop is provided to accommodate side-port loading at this shed.

The open storage yard for the handling and storage of bulky cargo, not affected by exposure to the weather, lies between the coastwise shed and the other buildings already described. This yard is surfaced with cinders and served by five pairs of railroad tracks.

Through the co-operation of the state highway department, Christiana Ave. linking the terminal with the state highway system and the business center of the city, has been paved.

Direct connections have been made to two of three trunk line railroads serving the city while the third reaches the terminal by way of one of the other lines.

In addition to the buildings already described there is a pump and transformer house, and booster pump house, a yardmaster's office and an administration building. The entire plant is sewered and has two distinct water systems, one for domestic supply and the other for fire protection with a 75,000-gal. water tank. The cargo buildings are equipped with a dry pipe sprinkler system.

QUAY WITH TRANSIT SHED IN FOREGROUND; WILMINGTON PORT DEVELOPMENT

The mechanical equipment provided consists of six electric storage-battery tractors, three electric storage-battery load carrying trucks, 60 trailers, four portable electric dock winches, one 18-ton locomotive crane and one 5-ton full portal electric gantry crane.

During the progress of the work, one modification was made in the original plans. This change was in connection with the bulkhead design. The soil on which the terminal has been built is alluvial in character and when the sheetpiles were driven, a mud wave set in which pushed the sheetpiles 14 in. out of line and crushed the wale against which the rear row of spur piles acted. The tie-backs, cinder fill and additional riprap stone noted in the description of the bulkhead construction were added at this time to stabilize the structure.

One feature of the plan is that everything is on one level. From the bulkhead back across the transit shed there is an upgrade of 1¼ per cent; otherwise, except for slight grades for drainage purposes, all of the floors are level. Likewise, the roads grade down from the bulkhead across the width of the transit shed to an

elevation of 4 ft. below the floor level of the wings. It is believed that this layout will be especially advantageous for tractor-trailer movement.

The present channel maintained by the federal government is 21 ft. in depth and 250 ft. in width. A contract has been awarded for the deepening of this channel to 25 ft. and its widening to 400 ft. with an 800 ft. turning basin in front of the terminal.

The plans and specifications for the work were prepared by John Meigs, consulting engineer, Philadelphia. B. F. Cresson, Jr., and Charles W. Staniford of New York were consultants on the construction until Mr. Cresson's death, since which time, Mr. Staniford has acted in this capacity.

The Du Pont Engineering Co. of Wilmington as general contractor has carried out the construction work. W. D. Twing has been resident engineer for the Board of Harbor Commissioners, and J. A. Crothers assistant resident engineer.

London Improves and Extends Its Transit System

Extends Subway to Outlying Suburbs—Enlarges Old Tube for Car Interchange—Adds Many Improved Buses

London Correspondence

FROM the point of view of travel facilities it is difficult to conceive a more convenient city in which to live and work than London. When digesting this statement it must be remembered also how London has grown. The nucleus really is formed by two cities, the city of London and the city of Westminster; these have long since joined and become one. Moreover, the suburbs, in the majority of cases, have originated as small hamlets within a few miles of Westminster or of the city of London and have been absorbed with the growth of the combined cities. It cannot be said that London was "planned" in any sense of the term.

Thus the subway system could not follow any preconceived plan but has had to be laid according to the needs of the districts to be served, irrespective of convenience of route or of operation. As each district has become linked up and developed, better transit facilities are demanded and the subways must drive a line that way so as to bring the inhabitants of that district within convenient reach of their work in the heart of the metropolis.

Regarding the service to the city itself, the map, Fig. 1, will give a better idea of this than any word picture. Here in this map is the oldest section of London, devoted entirely to business premises. Needless to say, since it is the oldest part of London, the streets are the narrowest and the most tortuous, so that surface traveling is extremely difficult. The section shown in this map is roughly ¾ mile by 1 mile and is provided with seven subway stations. The area shown in this map may be said to be occupied mainly by the big banks and the wholesale merchants' establishments and, undoubtedly, has more workers to the square mile than any other part of London.

The next busiest section of London is shown in Fig. 2, which is on the same scale as Fig. 1. This is served by eight subway stations and includes the headquarters of many of the largest industrial concerns in Britain as well as the Law Courts, part of the London University and London's great fruit and vegetable market, Covent Garden.

Perhaps one of the most interesting features of the London subway system is the linking up of the great trunk terminals. Each of these terminals is easily accessible from any part of the underground system, either by a direct route or by a change at one of the interchange stations. Some trains, in fact, run the circular route known as the "Inner Circle," which route includes practically the whole of the trunk terminals. To reach any of these terminals, then, the Londoner travels by his suburban underground direct to his terminal, or exchanges into the inner circle system at the

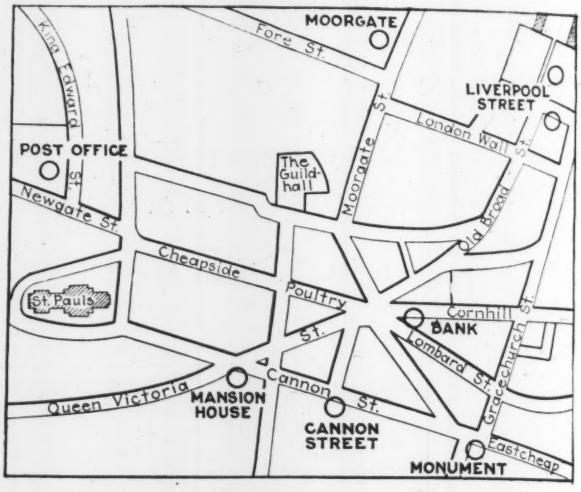

FIG. 1—SUBWAY STATIONS IN THE OLD CITY

most convenient point. Fig. 3 shows the relation of the trunk terminals to the subway system.

The residential districts of London are confined practically to north, northwest, west, southwest and southeast. Of these there is no doubt that the west is the most populous of the residential districts and is, accordingly, served best by the underground. The suburbs on the west side may be said to end with Ealing, a large suburb served by five subway stations. From Ealing Broadway station the business man can travel direct into the heart of the city in less than 30 minutes, a distance of about 10 miles. Similarly, direct through trains running from Hounslow Barracks, South Harrow and Richmond reach the city section in less than 45 minutes. The Londoner's choice of residence extends now to 15 miles from London's center instead of the 10 miles of twenty years ago.

The end of the year saw some notable improvements in the rapid transit system of London completed and in operation. Chief among them was the extension of the Hampstead line of the Northwest subway from Golders Green to Hendon, a total of 1.7 miles. The portion from Hendon to Edgware, a distance of 3 miles, let to the Foundation Co. of New York, is nearing completion. On account of the undulating character of the country, this line runs part of the way in tunnel, part in open cut, and part on embankment. The second notable piece of construction is the enlargement of the City & South London Ry. tubes from King's Cross to Clapham Common to make it possible to run standard cars in them. When this work and the Edgware extension are complete it will be possible for the first time

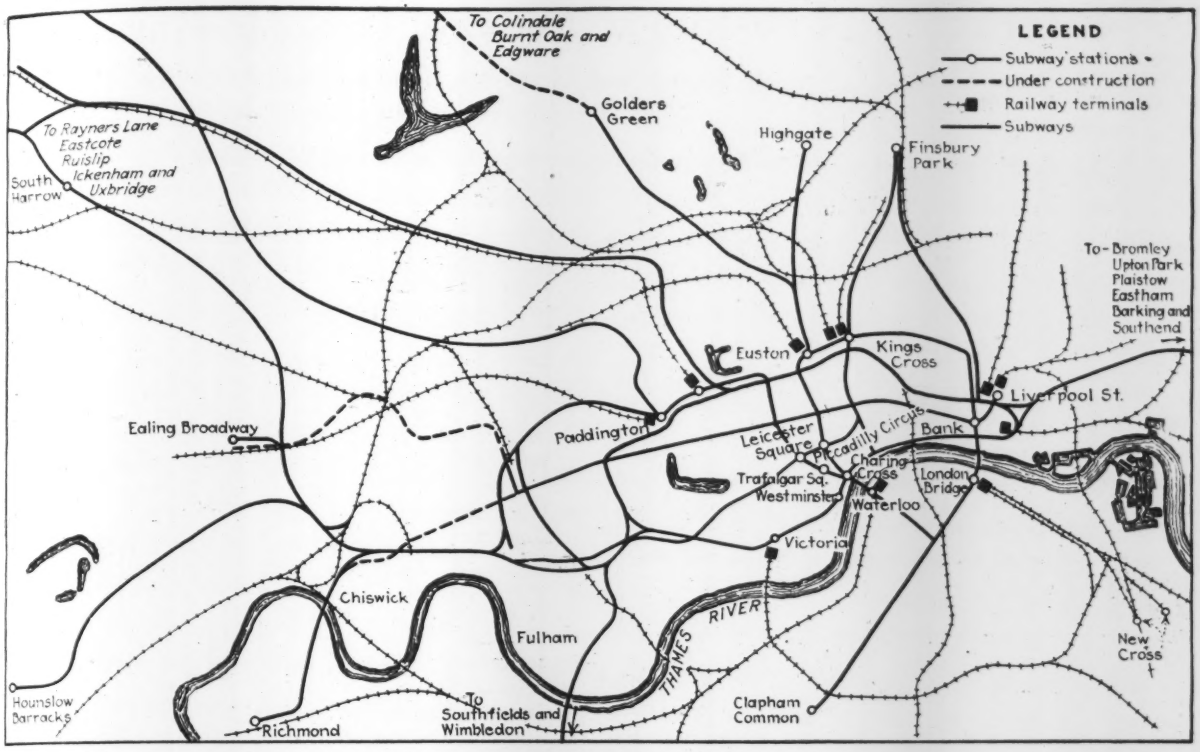

FIG. 3—RELATION OF SUBWAY SYSTEM TO TRUNK RAILWAY STATIONS

for passengers to travel completely across London from north to southwest, 16½ miles without changing.

This invasion of the outer suburbs of London by the subway system is regarded with some concern by the trunk lines, which have, up until now, held a monopoly of this traffic. The subway system will reach the extreme suburbs when completed, and will serve London within a radius of something like 14 miles. The electrification of some of the steam suburban lines will stimulate competition and will relieve the suburban traveler of some of the unjustified discomforts he puts up with in his daily journey.

Another development in the underground railway company's £6,000,000 improvement plan is to continue the Piccadilly line to Richmond and Hounslow, west

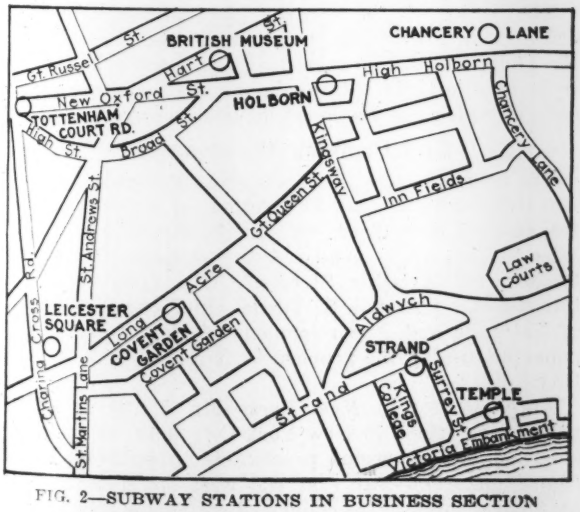

FIG. 2—SUBWAY STATIONS IN BUSINESS SECTION

suburbs of London, and the extension and modernization of many of the existing stations, including their escalator equipment.

Chief among the improvements is the so-called speed-up of the underground railways as the result of a press agitation for faster, more and later trains. It has made a very noticeable improvement in the five o'clock rush-hour conditions. On the surface the tramways are being so arranged that the various systems will be linked up across London. This will give some relief. New buses are being put on the streets by the transit combine at the rate of fifty per week. Some of them are of an improved covered-in type.

The suggestion that the control of the entire London traffic be vested in a single authority looks as if it would materialize at last. If it does, the present intolerable situation should be appreciably improved.

According to the operating manager of the London Underground Railways, striking as the transport progress in London has been, the rate of diffusion of population cannot be regarded as satisfactory. Considerable development has yet to take place in the transit facilities of southeast London. The electric trailways on the north side of London are becoming congested, and new direct lines from the northwest to the southeast and the northeast to the southwest through the center of London and pivoting on Piccadilly Circus are a necessity.

Iodine Water Treatment at Sault Ste. Marie

As a preventive of goitre, the city of Sault Ste. Marie, Mich., has adopted the plan of introducing sodium iodide into the city water supply at the rate of 2 lb. a day for two weeks, twice a year, according to Henry A. Sherman, city manager.

Technical Discussion at Am. Soc. C. E. Meeting

Abstract of Some Technical Committee Reports and High Points in Papers and Discussions at Technical Division Sessions of the Annual Meeting at New York, Jan. 16 and 17

AT THE annual meeting of the American Society of Civil Engineers at New York this year one day, Jan. 17, was given over to the simultaneous meetings of four technical divisions, highways, city planning, power and sanitary. The main technical features of these meetings, together with the high spots of the committee reports presented on Jan. 16, are given in this report.

Highway Division

Arlington Tests—A. T. Goldbeck, chief of the division of tests, Bureau of Public Roads, summarized the Arlington experiments of the bureau and announced some tentative conclusions drawn from the work, while Clifford Older, chief highway engineer of Illinois, similarly reviewed the Bates Road tests in that state.

The well-known circular-track running tests on concrete and bituminous pavements at Arlington Farm have been practically completed so far as the first set of pavements is concerned. The concrete pavements, made with a large number of different mixtures and various types of aggregate, tested by a set of loaded frames running on solid-tire wheels in tandem, withstood the equivalent of many years of normal traffic with insignificant wear; but when tire chains were put on the wheels a groove an inch deep was worn into the concrete in a relatively short time. The different concretes showed decided differences in wear; generally those made with stone screenings as fine aggregate, those containing soft stone, and those having an excess of fine aggregate showed severe wear. Stone with a wear coefficient of at least 6 proved satisfactory.

On the inner ring of the same track several dozen different bituminous pavements were laid. Continuous motor-truck traffic operated around this ring to develop shoving of the pavement surface produced little effect during the winter, but in summer the softer pavement mixtures shoved severely, as indicated by wave formation and by the distortion of radial lines painted on the pavement. Bitumens of less than 45 penetration did not shove. The concrete base under all the mixtures was troweled smooth, which favored shoving.

Pavement blocks of various sizes subjected to a heavy wheel load developed settlements closely proportional to the square root of their areas, not, as might be expected, proportional to the areas. Studies of moisture conditions in clay subgrade indicated that tile and ditch drainage are quite ineffective in reducing capillary moisture.

Illinois Tests—Among the many valuable observations reported in Mr. Older's paper on the Bates Road tests are the following:

Asphaltic concrete surfaces and bituminous-filled brick surfaces apparently do not add materially to the strength of the base, but by lessening excessive impact at small broken corners they give considerably increased resistance to progressive destruction.

Continuous longitudinal shear bars along the edges of concrete slabs aid materially in the mutual support of the adjacent edge corners for a more or less prolonged period, depending on the volume of traffic, and in addition are of marked advantage in preventing rapid progressive destruction in case corner breaks do occur.

Any design in which reinforcing steel is expected to relieve the concrete of all tensile stresses should take into account the possible formation of corners at any point along the edge of the slab.

Impact due to truck wheels passing over ½-in. to ¼-in. obstructions is negligible at ordinary speeds, the deflections produced being less than those observed under the stationary wheel.

Corner warping of as much as ¼ in. often occurs in slabs 18 ft. wide. The corners of rigid pavement slabs may frequently be required to sustain passing loads while acting as unsupported cantilevers. Stresses in corners may be greatly reduced by doweling. As transverse cracking may develop a corner anywhere along the edge of a slab, there should be continuous edge reinforcement.

Concrete subjected to repeated bending loads does not fail by "fatigue" if the stress produced is not greater than half the modulus of rupture; if more than half, fatigue failure results.

Macadam-base test road sections failed by rutting, sometimes with bulging alongside, the distribution of load to the subgrade evidently being inadequate.

Concrete pavements and concrete bases topped with a different wearing surface failed under loads $W = \frac{1}{3} Sd^2$, where S is the modulus of rupture; this is the ordinary bending formula. The breakdown of the pavement progressed from an initial break usually at the corner of a joint or a transverse crack.

Slabs with thickened edges containin a longitudinal bar showed greatly increased resistance. Pavements 5 in. and 6 in. thick with doweled central longitudinal joint and with edges tapered to 9-in. thickness from a point 2 ft. from the edge, the edge portion also containing a ¾-in. longitudinal rod, withstood 16,000 applications of loads ranging from 6,500 to 8,000 lb. followed by 12,000 applications of loads of 10,000 to 13,000 lb.

Edges designed to give a corner strength corresponding to $W = \frac{1}{3} Sd^2$, using for S a value not greater than half the modulus of rupture, should be sufficiently strong. The midportion of the slab may be proportioned by the formula $W = Sd^2$.

The value of the central longitudinal joint with doweling in preventing longitudinal cracking is shown, Mr. Older added, by experience with 1,500 miles of concrete road built in Illinois during the last three years, none of which has developed longitudinal cracks.

City Planning Division

The morning session of the City Planning Division was devoted to a business meeting, at which plans for future work were discussed. In the afternoon a largely attended meeting considered the subject, "Increasing Capacity of Existing Streets." The symposium was introduced by Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment of New York, with a paper discussing the problem as it relates to New York City.

Traffic Relief in New York—Mr. Tuttle said that police regulations in New York City have been carried about as far as seems practicable in reducing traffic congestion. One-way east and west streets have been established through the congested sections and two main

north and south arteries are controlled by signal systems. It is accepted on all sides that further relief is urgently needed in order to cope with the present, to say nothing of the constantly increasing, traffic needs. The breaking through of new avenues or streets is too expensive to be continued. It has been estimated that in the heart of Manhattan the cost of putting through a new express street 100 ft. wide would be at the rate of about $25,000,000 per mile.

To provide the relief now demanded by utilizing the existing streets, the following expedients may be considered: (1) Requiring new buildings to set back to lines proposed for ultimately widening the streets; (2) widening roadway; (3) more drastic traffic regulations; (4) removal of roadway encroachments; (5) bypassing of traffic, and (6) introduction of arcades. Mr. Tuttle discussed each of these separately.

Requiring a setback for future widening is now unconstitutional in New York State, except under the restrictions of the zoning law in certain specified areas. Resort in New York has been taken, however, very considerably to the widening of roadways. This began on Fifth Ave. in 1908 and has continued in a number of other streets. The process is to first remove all sidewalk encumbrances; then generally to narrow the sidewalk, and to extend the roadway width. On the matter of traffic control Mr. Tuttle recommended an extension of the one-way traffic system, and area and block control. Great progress, too, is being made in New York in the removal of roadway encroachments, such as elevated railway columns, subway station entrances, subway ventilator gratings and malls. Active efforts are being made in a variety of directions to bring about the restoration of the streets to the use for which they were designed.

Under bypassing of traffic, Mr. Tuttle referred to the project for an expressway along the Hudson River water front, utilizing different levels for truck parking, motor expressway, and freight railways. Under arcaded sidewalks, the paper referred rather extensively to the system of arcading which Mr. Tuttle proposed before and which has been noted in an article in *Engineering News-Record.*

Mr. Tuttle was followed by Harvey W. Corbett, a New York architect who is consulting with the Sage Foundation in its study of regional planning in and around New York City. Mr. Corbett first commented upon the fact that the automobile is not the only cause of congestion in New York City, where the buildings are practically all concentrated in a narrow area up the spine of the island. The difficulty there is the bulking of the buildings in relation to the streets. However, in his studies he has decided that for the future traffic must be separated definitely into three classes, none of which will interfere with any other. These are the foot traffic, the wheel traffic, and the rail traffic. He makes a logical division of these three kinds by putting the rail traffic all under ground; the wheel traffic, which is growing faster, on the present surface; and the foot traffic raised one story on second-story streets. He showed a number of sketches of buildings in the congested area of the city after such a plan has been carried out. It will be necessary in New York, of course, to undercross the streets at the avenues. With such a system there would be little danger of congestion because each kind of traffic could continue moving without interference of the other.

Jacob Crane, Jr., of Chicago, read a paper written by himself and C. D. Hill, of the Board of Public Improvement, on the double-deck street which carries Michigan Ave. across the Chicago River, and gave the figures of the economy of such streets, computed by capitalizing the daily saving in the movement of truck freight.

Discussion on Traffic—E. P. Goodrich, of New York City, said that the scheme for physical separation of traffic by structures would undoubtedly have to come in our most crowded centers, but that it was very expensive and that for some time ahead relief must be sought by better means of traffic control. He suggested a platoon system of traffic for cities such as New York whereby the north and south traffic moves in blocks or platoons and the east and west in similar platoons, synchronizing so that the east and west block passes across the north and south street in the interval between the blocks on that street. This, he said, could be laid out over a large area and controlled from a central station.

Harland Bartholomew, of St. Louis, in discussion said that a lot of the theories of traffic control seemed to lose sight of the fact that they were merely adding to traffic by adding to the number of people that could use a given area. He said that it was necessary to carry on a more complete census of city traffic. He felt that it would be found that in the crowded districts only 10 per cent was commercial; the rest was individual cars, many of which could be well eliminated from the district. He said that it was impossible to eliminate surface street-cars in most cities, and that not ten cities in the country can afford subways; he criticised Mr. Corbett's plan as being applicable only to New York. He did not think that provisions should be made for either parking or loading trucks in a city street.

George F. Davison, of Pittsburgh, said that he had recently been on a traffic commission in Pittsburgh and that he was slowly coming to the conclusion that certain kinds of traffic must be suppressed. There were limits to which private cars should be allowed on public streets to the detriment of the necessary traffic. Obviously, he says, one could not expect a city to spend money to put traffic below ground in order to allow a very few to use the ground areas which were thus provided. If such a development were required, the assessment should be heavy upon the private passenger cars, which are the principal cause of its being demanded.

Power Division

The morning session of the annual meeting of the Power Division was opened with the presentation and adoption of a new constitution for the division, prepared at the request of the Board of Direction in order that all the divisions might operate under similar constitutions. This was followed by the reading of a letter from the Hydrotechnical Society of France asking for advice concerning the silting-up of reservoirs and channels used for powen purposes. After some discussion as to the needs of study along this line and for co-operating with the French engineers on a subject of such vital importance to them, the letter was referred to the executive committee for action.

Draft Tube Tests—The paper for discussion at the morning session was on comparative tests of experimental draft tubes, and was presented by C. M. Allen and I. A. Winter. The discussion which followed had particular reference to the fact that the paper as prepared and published in the November *Proceedings* did

not include enough data to be conclusive, and particularly that the paper did not give some data developed by Professor Allen in later tests. Professor Allen remarked that these later studies of his could not be included in the joint paper as Mr. Winter had no part in making them and also because all manufacturers had not been given an opportunity to submit draft tubes for testing at the same time. He also thought that the proper place for the results of these latter tests of his to come out was in this discussion of the paper which he and Mr. Winter had prepared. Moreover, he said that the results of these tests had been brought out in articles in *Power* and in *Engineering News-Record* (Aug. 2, 1923, p. 182) describing tests made by Hugh L. Cooper & Co.

Professor Allen said he realized that the tests upon which the joint paper was based were not as comprehensive as could be desired, but pointed out that funds were not available for continuing the tests and emphasized the need of proper facilities and adequate funds for much more extensive ones.

John R. Freeman called attention to the fact that the draft tube was nothing new, that Swain had appreciated its value some fifty years ago. R. A. Hale said that he had made tests on the Swain wheel in June, 1869, and that a waterwheel was put out in 1883 which had a draft tube with a center cone, that the holders of recent patents on draft tubes showed a peculiar interest in this old draft tube which was so similar to the modern one.

The afternoon session was given over to the discussion of the absorption of hydro-electric power by existing systems. The discussion was opened by John P. Hogan and William B. Jackson, giving a description of the methods of preparing and using diagrams in the study of the most economical relation between hydro and steam power in any given system. The discussion centered upon the correct method of computing the value of new installations in relation to existing plants, but little of value on this question was brought out.

Sanitary Engineering Division

The Sanitary Engineering Division, organized a year ago, held a dinner meeting Tuesday, and two sessions on Thursday, joining at lunch on that day with the New York section of the American Water Works Association. On Friday the division inspected the Woodside sewer tunnel, storm overflow and fine screening plant in the borough of Queens; the new 300-ton Decarie refuse incinerator at 12th Ave. and 56th St., Manhattan; and the Beccari garbage fermentation plant put in operation last December by the village of Scarsdale, near White Plains, N. Y.

Sanitation and Health—After the dinner, at which the attendance was 69, Prof. George C. Whipple of Harvard University gave an address on "Sanitation, Its Relation to Public Health." The address was a plea for a broader conception of the relation between sanitation and health, and for the avoidance, if possible, of administrative cleavage between what has become known as "the new public health" and sanitation. The speaker urged that the health campaign is weakened by the qualifying word "public." Among the environmental conditions which affect public health he listed: (1) damaging factors—infections, poisonings and accidents; (2) functional factors—water, air, food, light, temperature, humidity, sleep, exercise, clothing, shelter; and (3) transitory factors—smell, taste, sound, sight, touch and temperature. In conclusion, Professor Whipple summed up the relationships between the sanitary engineer and health as follows:

> Looking back a century or more, we see the beginnings of industrialism, the rise of the factory, and the growth of cities as a result of science and engineering; we see the early evils of industrialism leading to a humanitarian movement; we see the great sanitary awakening at the beginning of the Victorian era. Then came Pasteur, the science of bacteriology, and the new public health. Now with advanced ideas of industrial humanics, housing, and city planning, we are entering upon a new era of sanitation, and once more the engineer must lead. Industrial revolution and a rude economic awakening are already upon us. The age of power is becoming the age of super-power; city planning has already become regional planning; decentralization of population is coming. The new problem is not so much how to educate a few sanitary engineers, as how to educate all engineers to work in the interest of health and life.
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> The sanitary engineer especially comes close to life. A knowledge of biology is fundamental to his success. His work is a contribution to the great elements of life. He has opportunities to protect and promote health and comfort. He has opportunities to protect the beauty of trees, streams, lakes and ocean shores, to build beautiful structures, to utilize the latent beauty of falling water. Although burying much of his work underground, he makes possible the development of noble city plans. Through organized cleanliness he makes it possible for the beauties of architecture to be revealed. The new architectural roof motive, already evident in New York, resulting from the restriction of building heights is an outgrowth of a sanitary demand for adequate light and air. Through insistence on individual responsibilities in public sanitation there is being developed a moral sense of duty and a spirit of co-operation, which is the very soul of civilization.
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> It is well at times for sanitary engineers to stop and look at these things, and even to indulge in a little self-conscious professional pride, in order to encourage young men to enter this field of work. We can testify to them that sanitary engineering is a worthy, beneficent calling. It offers a sufficient living, opportunities for scientific achievement in varied fields, and many pleasures by the way. Some of us who began work just at the time when the spirit of Pasteur was stimulating all public health efforts have witnessed striking changes in living conditions due to improved sanitation of air, soil, water, food, streets, houses, factories, and public buildings. We have seen pestilences yield to science. We have seen the art of water purification accelerate until a grossly polluted public water supply is now almost a thing of the past. We have seen the art of sewage treatment push towards the goal, but with many yards yet to go. We have seen city and regional planning develop as the art which is to save our cities from their own colossal folly. We have seen chemistry, biology, and engineering unite in solving our sanitary problems. We are now seeing young men from all parts of the world coming to America to learn the arts of sanitation and health promotion and returning to their several countries to practice them and teach them in their own universities. World-wide sanitation is looming ahead as a twentieth century possibility—I may even say a necessity, for we are fast entering an age in which our unit of environment is the world.

In discussing Professor Whipple's paper H. N. Calver, secretary of the American Public Health Association, stated that in dealing with health matters engineers were inclined to run too much to engineering and doctors too much to medicine. A middle course is needed and a public health profession. T. C. Hatton, chief engineer, Milwaukee Sewerage Commission, said that failure to receive more public recognition for sanitary engineers than is now given, rests with themselves. The

majority of the engineers present, he said, would define sanitary engineering as confined to water supply, street cleaning and the like, which is also the opinion of the general public. He called attention to the fact that in taking up traffic regulation at Philadelphia, General Butler, the new chief of police, did not call in engineers. Prof. John H. Gregory, Johns Hopkins University, expressed the belief that medical men now give more credit to the sanitary engineer than formerly.

Friction of Sludge—Glenn D. Holmes, chief engineer of the Intercepting Sewer Board, Syracuse, N. Y., reported for the division Committee on Friction of Sludge that consideration was being given to the Saybolt viscosimeter for determining the friction of sludge in passing through pipes. Two tentative conclusions as to sludge friction have been reached by the committee: (1) That for undigested sewage sludge with 96 per cent moisture or over the friction is about the same as that for water while for heavy paper stock the same is true at and above 98 per cent of moisture, in each case the friction increasing with the decrease in the percentage of water.

Rainfall Intensity Study—A paper on "Distribution of Intense Rainfall and Some Other Factors in the Design of Storm-Water Drains" was read by Frank A. Marston of Metcalf & Eddy, Boston. (See January *Proceedings*, Am. Soc. C. E.) A somewhat lengthy oral and written discussion followed, in the course of which George T. Hammond of Brooklyn gave tribute to "three men of revered memory" who had done notable work in the field of storm-water sewer design—Rudolph Hering, Charles E. Gregory and Emil Kuichling.

Imhoff Tanks—A symposium on "Imhoff Tanks—Comparison of Operating Results" was opened by a lengthy paper contributed by Harrison P. Eddy. The paper compared design operating factors of two sets of tanks that have generally been regarded as typically successful, and two others which have given rise to trouble, the first pair being at Rochester, N. Y., and Fitchburg, Mass., and the second at Schenectady, N. Y., and Plainfield, N. J. Fine screening was characterized as a factor of safety in Imhoff tank operation, but it was pointed out that satisfactory results were obtained without it. There are no comparative biological data for Imhoff tank operation Mr. Eddy stated. Following Mr. Eddy's paper there was extended discussion by George T. Hammond of Brooklyn, J. F. Skinner, designer of three of the four Imhoff tank plants at Rochester, and John R. Downes, superintendent of the Plainfield joint sewage-works.

Technical Committee Reports

Progress reports were submitted by fourteen of the society's technical committees: Impact in highway bridges; stresses in structural steel; fire prevention of docks, piers and wharves; bearing value of soils; stresses in railroad track; highway engineering; bridge specifications; standard construction contracts; concrete arches; electrification of steam railways; flood protection data; irrigation hydraulics; hydraulic phenomena; steel column research. A few points from these reports are noted here.

Highway Bridge Impact—Impact tests were made during the past year near Ames, Iowa, on four steel highway bridge spans ranging from 33 to 150 ft. long, all with concrete deck. Trucks and tractors were run over them, on the unobstructed floor and over blocks placed on the floor. Results are not yet available. Some of the stress measurements were made with the new carbon-resistance strain-gage developed at the Bureau of Standards, and it is planned to buy for the society a twelve-element gage of this type for the further impact work.

Structural Steel—The quality of commercial structural steel was studied by the committee on stresses in structural steel collating the test reports of 3,500 specimens from a number of mills with respect to yield-point, all coming within the accepted range of ultimate strength from 55,000 to 65,000. Less than one per cent of the specimens showed a yield-point below 30,000, and the committee therefore recommends that specifications should not admit material showing a mill yield-point below 30,000, whereas most existing specifications admit a minimum of one-half the ultimate strength.

Concrete Arches—The new committee on concrete and reinforced-concrete arches has begun tests on a bridge of seven 119-ft. spans with 32-ft. rise, now under construction at Conneaut. This work was undertaken in co-operation with the Ohio Highway Department, which not only provided facilities but also contributed $1,500 toward the cost of the tests. The piers are founded on rock, but rotation of the pier bases nevertheless is perceptible. Distortion measurements on piers and arch rings and internal temperature measurements are in progress. Readings are also being taken on a duplicate of the crown section, 6 ft. long, poured on supports on the ground at the time the arch was poured, to get a comparison of deformations with and without the presence of arch stresses. Strain-gage readings on members of the arch-ring centering are also being taken; the centering is a three-hinged arch truss.

Another test has been begun on an existing arch bridge at Danville, Ill., in service for two years past; temperatures and distortions are being measured. Plans are on foot for tests on a third bridge, to begin at the time construction is started. The committee's work will also include laboratory tests on the elastic moduli of concrete and on the effect of slenderness ratio of thin and narrow arch ribs when unsupported during construction.

Pier Fire-Protection—Reviewing a report drafted by the National Fire Protection Association on the fire hazard of docks, piers and wharves, the committee on this subject proposed extensive amendments to that report in order to obtain better resistance to fire and more practicable construction. The work cover fire-resistive and non-fire-resistive construction, treatment of existing piers to improve their fire resistance and provision of fire-fighting means. Recommendation was made by the committee that the society establish a standing committee on building construction to deal with fire resistance.

Low Per Capita Water Consumption in London

The per capita water consumption in the Metropolitan District of London, England, for the year ended March 31, 1923, was 42 U. S. gal., according to the latest report of the Metropolitan Water Board. This was a decrease of 1.64 U. S. gal. per capita from the previous year. In commenting on the rate of consumption *The Engineer* says that it is high compared with that of "provincial centers, but the board apparently acquiesces in it on the ground that the conditions in the metropolis necessitate a relatively higher consumption than in other parts of the country."

The Engineer's Place in the World

Two Speeches at the Dinner of the American Engineering Council at Washington, Jan. 10, 1924

By Herbert Hoover

Secretary of Commerce

I NEVER MEET with the Engineering Council without a keen desire to repeat certain ideas that I have perhaps over-repeated in the many times that I have met with you before, but these subjects become perhaps more appropriate of the moment in view of the recent success in obtaining a sum of money for a sufficient and accurate survey of our educational institutions in respect to engineers and their alliances and, therefore, while we as other engineers are interested only as observers, we are perhaps able to bring some opinion on that survey by a kind remark. We are all of us interested from an Engineering Council point of view in the relationships of the engineer and in the relationships of our own engineers and their subsequent relationships to public service. Engineering Council is an attempt to express the views of the American engineer on questions perhaps considerably afield from engineering. It was constructed in the hope that the engineer might take his place amongst the associational activities of the country, in an expression of the engineer's mind on public questions; that he might take opportunity with other great associational activities in moulding policies perhaps not altogether of legislative complexion, but policies rather of a social and economic complex. It was thought by those of us who entered into the formation of the Conference that the engineer had something to contribute; that his training was a training of great precision, of great definiteness of thought, of careful and weighted preparation before expression, that his association in his professional life brought him into contact with the human as well as the purely economic and industrial questions with which he dealt.

We felt that he stood perhaps between these great conflicting forces in some particular, especially between labor and its employer. We thought perhaps Engineering Council could offer something to both sides that would be a contribution. We felt that an expression from the engineers of the United States on legislation, both national and state, as well as municipal, that bore upon questions to which pure engineering sciences were related, would be of far more value than the opinions then so readily grasped. All these were objectives of Engineering Council for three or four years and met with a very considerable measure of success.

On the whole we have had the support of the engineering profession, the entire profession. But many of our engineering brothers are still enveloped, at least to some degree, in the belief that the engineering position is one of the technical mind, that the engineer must keep himself more or less free from participation in public service if he would properly safeguard his association. We have agreed to disagree among some of our own people.

We are facing a time in the development of our civilization when we must find some sort of a bridge between the extreme individualism of the last century and the possible inroads of those forces that would extinguish that individualism entirely. There is somewhere to be found a plan of individualism and associational activities that will preserve the initiative, the inventiveness, the individual, the character of man and yet will enable us to socially and economically synchronize this gigantic machine that we have built out of applied sciences. Now, there is no one who could make a better contribution to this than the engineer, but to make that contribution our engineers in the future have got to have a broader and stronger place in our world affairs than they have today. We can not be turning men out of our universities as we are in many cases today purely mechanical machines devoted to some theory built on applied sciences. If the engineer is going to take his part in this community, is going to give expression to those things that he can express best, he must start with a sense of his public obligations as well as his professional knowledge.

Now the engineer really has a contribution to make, with his precision of thought, his capacity to analyze conclusions and to obtain the proper perspective of fact and his ability to weigh the forces with which he deals. He has a place beside our commerce, a place beside our social problems, that is not yet filled. I have said at times that one of the difficulties of my own position is that I am presented with economic arguments pro and con in some matters in which I must find an interpretation from forty arguments on one side and ten on the other, and the average economist wishes to balance the thing three-fourths. It is the engineer who can take these arguments and weigh them in their human units, and can draw a balance sheet upon which the policies and ideals of the country can be formulated.

But we are not going to attain this position for the engineer, this right and this obligation on his part to take his position in national councils, to exert his opinions alongside of even the organized farmer, the organized laborer, the organized chambers of commerce, unless the engineer himself has been broadened out of the narrow groove that most of us were deliberately trained in when we were boys. I realize in the presence of the greatest educator of the United States that I am perhaps talking heresy. I realize that the area that we must cover in education has now become so broad as to be almost exhaustive. I realize that my grandfather went to school for five years; that my father went ten years, and I went fifteen years, and that my son is now engaged in studies that will cover full twenty years, but we had better reduce the volume of science and applied science we are pouring into our young men in order to make room for some stimulation of their public relationships, some realization of their public obligations.

I am not speaking of this even as a matter of cultivation, cultivation of mind or cultivation of character. I myself do not believe there is any greater cultivation than that of an engineer's training in itself. But what we want here is the thing that Engineering Council was founded to procure, and that was the employment of the engineer's mind and method of thought in his community. We are not going to have that full value until we have brought by a new generation of engineers of wider individual attainments than those to which you and I belong a keener realization and appreciation of these matters. And I give that thought to the gentlemen in front of me who are to be related to that new survey of engineering facilities now in process. And it is precisely for this reason that I am anxious to see Engineering Council continue and grow strong because unless we have some central point that at least keeps the lamp of public service and relationship alight in the engineering profession, we shall go back into the dark ages where we were twelve years ago, in our perhaps hermit-like attitude toward public service and questions.

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By Nicholas Murray Butler

President, Columbia University

I WAS GREATLY impressed by the message which Mr Hoover gave to this company, and I find myself in entire agreement with him, both in spirit and in detail. It has been my lot for many years to watch professional education, see it develop, to observe the forces both in the universities and technical schools and in the world of affairs that are operating upon our professional education. I have been struck by the similarity of the problem wherever it appears, whether in the older professions of law and medicine, or in the newer groups to which engineering belongs.

They have all passed through pretty much the same series of phases. They all began with some form of apprenticeship system: the youth a pupil working with the master; after a time a sufficient body of knowledge was gotten together to make it essential that the youth should devote some part of his time to acquiring that knowledge: then the youth mastered the principles upon which that body of professional knowledge rested until finally there came into existence large and well-equipped institutions throughout the world to offer training for the great profession which you represent.

All these professional movements have had the same problems to meet, they have had to deal with the same temptations, the same dangers. They have made pretty much the same mistakes and curiously enough they have, for the most part, failed to take advantage of each other's experience.

Let me counsel those of you who are going to make a study of engineering education not to overlook legal and medical education, at least in outlining, because you will discover from the experience of those who conduct legal and medical education very many points of interest to you. It may be of some significance to you to know that in my judgment, at least at the present time, the best type of engineering education is an advance of the best type of legal or medical education.

There have been some very curious shifts and changes in the last generation and general advances have been, I think, with those institutions which train for engineering. It is also very interesting to see professions come into existence. There used to be the three professions in Ancient Rome, a profession of Arms, a profession of Eloquence, and a profession of the practice of the Civil Law. Now there have come into existence a great series of professions by their side, and I wonder sometimes whether all of the major activities of men may not be susceptible of being developed into professional form. That means they must have a body of ascertained and definite knowledge upon which to rest. They must have a tradition of disinterested service and they must have ideals of intellectual or scientific or professional progress that will keep them from dying.

I do not know how we can define a profession. We can describe it, but I do not think I know how to define it, and I am sure the dictionaries do not, because I have many times looked in them for help; one of the best ones used to say a profession was one of those activities that has to do with man and trades and occupations have to do with materials, but that distinction has no permanent significance in the complicated life of today. I suppose an engineer, broadly speaking, is one whose task is to apply means to definite ends in the material life of man under the limitations of economic law. Whatever else he does, he has to do that. Therefore, of his nature, he is a constructor, he is a builder; he is not primarily a critic; he is not primarily an essayist, a describer; he has a task to perform and that task would seem to me, generally speaking, to fall within the limitation of the definition which I have just attempted.

Now the difficulty with all our professional education, and that applies to engineering, is that in the ambition of the teacher to do as much for his pupil as possible he too often aims to make a youth of twenty-two or twenty-three the equal in knowledge of the ripe, experienced and professional man of fifty. He is not content to give him the foundations, the principles, the background, the method, but he wants to give him a knowledge of the detail of the professional activities of the moment. There are two great difficulties in the way of that: the first is, it can't be done, and the second is that the things you are teaching about change while you are teaching. Somebody in a mine, in a factory, in an electrical establishment, or a hydraulic plant, is improving the very thing you are talking about and what your youth really needs to know is not that particular mechanical or physical detail, but those principles which will enable him to improve whatever physical or mechanical detail he may find himself in contact with.

The lawyers are doing the same thing. If you read an examination for admission to the bar in many states you will find they are asking the sort of question which Elihu Root, Joseph Choate, or Justice Taft might be supposed probably to answer at the conclusion of a long and distinguished career. I will tell you that precisely the same thing exists with medicine: they are not content with a clinical introduction—and the clinic is the laboratory of the physician—they are not content with the clinical introduction to the fundamentals of disease, they want to be perfectly certain he knows them all and can cure them all.

Until we can give up that notion of professional education, give it up once and for all, and be content with the notion that a young man is still young, that however much you teach him, experience will teach him something more, and that the light of his professional career, be it engineer, physician, lawyer, or teacher, must be given a chance to do its share. Then and then only will you fix an ideal which even the best and most rational education institutions will be able to serve.

Your profession is one of the newest. One hundred years ago it was, with the exception of a few geniuses, a trade, a calling. It has come to be a profession. It has come by the steps that I have mentioned, and, curiously enough, it has come at a time when not only within the ordinary scope of its application and activities is there demand for it, but when, as Secretary Hoover indicated just now, there is a very large and important place for it in the public life of man.

All our public activities of every kind, wherever we organize ourselves together, in communities, states, governments, present two fields of thought, two fields of action. One is that which the lawyer has made his own and I might say some unkind things about that, but I won't. That is the field of legislation, law-making. Modern public opinion has apparently relied exclusively upon law-making, upon parental direction in statutory form, frequently punitive, frequently criminal, frequently with severe penalties attached. When the statutes are not of that kind, they are very minute and meticulous in their control of all forms of public business and activities of agencies. The consequence is that government has become almost impossible because it is involved in its own technicalities. There is so much machinery that the machinery won't work and cannot be worked. On the other hand, the real field for progress is the field of administration, and there we tie the hands of everybody, tie them hand and feet.

The engineer is an administrator of necessity, and what we want, what the people of this country and the world want, is more emphasis on administration and less on legislation, more on the engineer and less on the law-making power.

The difference between government and business is this: In government you make laws and do the best you can and make them work. In business you go to work and develop such laws as the work requires. The two points of view are absolutely opposite.

If we are going to get ahead, get out of these conditions under which men are so restless, we have got to let our administrator be free to administer, our doers free to do, untie their hands and the public will find somewhere to get its expression in contact and policy.

I would like to see less legislation and more engineering in the public life of the people. I would like to see a larger scope for the administrator, putting down in his area defined by law designated amounts at his disposal for expenditures, ear-marked if you please, but give your administrator discretion to do business in your service exactly as you give to the business administrator, or the engineer, discretion to use his skill, his experience and his power in the service of the particular organization that has asked for his service.

These public interests won't wait forever. It is a mistake to suppose they belong to political parties. They belong to all of us. We or our ancestors made them. They are left to us as trustees. We are responsible for the work of the social, political and economic systems and it is astonishing how much of this work would fall under the head of engineering, properly described and defined.

So I say to you gentlemen that the field in which you are working, however broad or narrow particular interests may be, is of the very largest public concern, not alone because your enterprises have a public reference and interest and are often maintained by public authorities, but because you are abutting on public problems that, on the surface, do not appear to be related to engineering at all, but are related to that good citizenship, and that effective citizenship which every well trained and high-minded American engineer will use to illustrate in his own person. If we think straight about these matters we shall see that to get things done we do not want obstacles, balances of power, restrictions. We want definite authority confined within specific limits with designated amounts available for expenditure and capable brains to work out the problems in the public interest, and that I call public service, engineers.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Device Holds Steel Parting Strips to Grade and Alignment

By H. J. Kuelling
Wisconsin Highway Commission, Madison, Wisconsin

AN INTERESTING device for use in setting steel parting strips in concrete pavement was devised and used by a foreman in the employ of Winnebago County, Wisconsin, during the summer of 1923.

The installation of steel parting strips used in roads constructed with the central longitudinal joint is always attended with more or less difficulty, especially where 18-gage metal is used. Where stakes are relied on entirely to hold this material, the careless dumping of the bucket will push the steel out of line which causes an extremely unsightly appearance.

PLATE HELD IN ROAD CENTER BY UNIQUE DEVICE

The purpose of this device is to make it possible to install these steel parting strips to line and grade while the concrete is being deposited on either side of it. The cross members of this device are constructed of T-section steel. The cross members support a bar at the center constructed from a series of flat plates bolted together in sections in such a way that the bar can be adjusted to fit the radius of any curve. Holes are drilled in these plates which carry a set of straight pins on one side, and a set of offset pins on the opposite side. The offset pins are so bent as to make allowance for the crimp in the metal. A cover plate made of channel steel covers the bolt heads so they are protected from the concrete. The frame is adjustable so it can be used on any width of concrete up to 20 ft. It can also be used on a superelevated luned curve without shifting forms.

This device is set down over the steel and after the concrete has been deposited on either side of the plate, it is picked up and carried forward and the operation repeated.

The use of this device not only insures accurate centering and good alignment, but it also takes care of the elevation of the upper edge of the metal. The standard practice in Wisconsin is to finish the concrete one-fourth inch above the upper edge of the parting strip.

Concrete Bridge, Damaged by Flood, Raised and Foundation Restored

By L. K. White
Office Engineer, Sedgwick County, Kan., Wichita, Kan.

EXCESSIVE rains during May and June, 1923, did considerable damage to highways and bridges in Sedgwick County, Kan. As an indication of the heavy rainfall between May 21 and June 15, inclusive, there fell 18.36 in. of rain when the normal precipitation for that period is only 4.8 in., and the maximum 30-day precipitation 10.6 in.

During this rainfall, which reached its greatest intensity on June 8, when 6.88 in. fell in 24 hr., 90 bridges in Sedgwick County were destroyed. It was not until Oct. 1 that work upon the bridge pictured here, which is on the Cannon Ball Road west of Wichita, was begun.

The water course over which the bridge here shown was built is known as a branch of the Ninnescah River, known as Polecat Creek, and is a normally dry stream at this season of the year. However, it carries the runoff of about 3,200 acres of rolling agricultural land. The bridge is a 30-ft. reinforced-concrete structure of through-girder type, having a 20-ft. roadway and was designed for a 20-ton tractor loading. The substructure is of plain concrete, gravity type, 13 ft. high from base to bridge seat. The wings are 15 ft. long and set at an angle of 45 deg. with the center line of the road. The abutment design is according to the empirical formula for design of gravity retaining walls. The foundation is a coarse sand mixed with boulders of soft shale.

During the rain of June 8 water reached an elevation about level with the roadway and had sufficient velocity to remove a large amount of dirt in the waterway of the bridge and on both sides. The earth on the west side was scoured until the west abutment was undermined and the pressure exerted by the backfilling moved the entire abutment inward about 1 ft. at the base and leaned the top inward 3.5 ft. The superstructure was lowered about 15 in. at the west end and due to the unequal settlement of the abutment the load was carried at three points. The paving slab was supported level with the bridge by a step cast on the back of the abutment and the settling of the abutment at the backfill broke off a solid section of the pavement 12 ft. in length. This three point cantilever loading of the bridge made two diagonal cracks in the slab and also cracked the north girder near the east end.

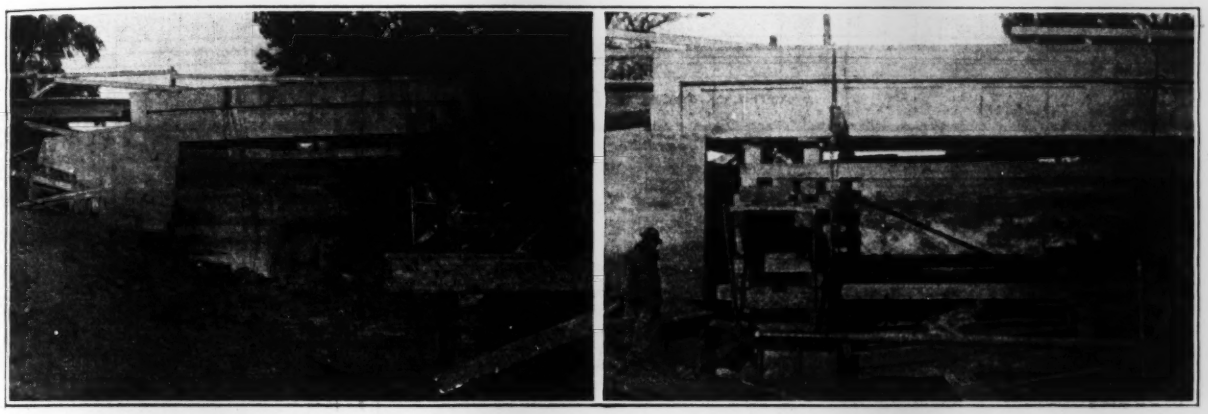
Immediate temporary repair included placing 10 x 10-in. timbers between the abutments near the top, one on each side of the superstructure. A temporary crossing was provided and served traffic while county bridge

gangs were replacing bridges where temporary crossings were not so easily made.

To reconstruct the bridge concrete piers 6 x 6 ft. in plan and 5 ft. high were built under each girder near the west end to furnish a foundation for cribbing and jacks in order to raise the superstructure. The estimated load on these piers produced a soil pressure of 3,000 lb. per square foot but no settlement occurred.

The temporary crossing had been provided by bridging over the structure with four 45-ft. 18-in. I-beams using 3x12-in. 16-ft. bridge planks for flooring.

Cribbing for supporting the jacks used in lifting the superstructure was built up of 10 x 10-in. timbers 5 ft. long. The same size timber but 20 ft. in length was placed in position horizontally at each corner of the abutment and at an elevation just above the center of gravity. Two hydraulic jacks of 100 tons capacity were used to raise the superstructure, which was then blocked with wedges at an elevation two-tenths of a foot above a level position. Jacks were then placed in a horizontal position at the end of the 20-ft. timbers and cribbing filled into the east abutments. By careful manipulation of the jacks and the excavation under the wings it was possible to shift the abutment back into place.



BRIDGE ABUTMENT, ENDANGERED BY SCOUR FROM FLOOD, RESTORED BY JACKING

Sandblasting and Painting Rusted Steel Penstock Line

By George H. Bragg
Maintenance Engineer, Pacific Gas & Electric Co.

When rust barnacles of extraordinary size and pits of unusual depth were found in a penstock on the system of the Pacific Gas & Electric Co. after the line had been in service a comparatively few years, sandblasting was employed to clean the pipe prior to its being painted to arrest further rust deterioration. The penstock line is fabricated of steel plate varying in thickness from $\frac{5}{16}$ in. to $\frac{3}{4}$ in., rolled and riveted together making a pipe varying in diameter from 7 ft. at the upper end to 4½ ft. at the lower. The total length is about 6,700 ft. and the penstock furnishes water to the Wise power house which has a capacity of 12,500 kva. and operates under a head of about 500 ft.

The direction of the natural draft in the pipe was usually from the lower to the higher elevation. This draft was augmented by fans causing the air to move at about 6 ft. per minute. Wooden bulkheads were placed in the pipe at high points in the profile to permit simultaneous operation by a number of crews.

Sandblast machines were taken inside the pipe and placed close to the working area, it being found that best results were obtained with not to exceed 50 ft. of hose to the nozzle. The air supply was conveyed from compressors by a line of screw pipe laid parallel to the penstock, thence by rubber hose run through the rivet pass-holes in the penstock to the machines inside. Rivet pass-holes also were used as means of leading the lighting wires inside and routing sand in and out. The machines were set under the holes and the sand was poured directly into them through funnels. After being discharged, the mixture of rust and sand was scooped into the machine and blown outside through the nozzles inserted in the rivet pass-holes, this process separating the heavier particles of clean sand from the rust so that 30 per cent of the sand was recovered.

Best progress was made on sandblasting when two 8-hr. shifts were employed consecutively to sandblast, after which the third shift cleaned up, moved the equipment ahead, and put it in order for use by the next shift. From 5 to 7 lb. of sand were used per square foot of pipe cleaned. Graded Monterey beach sand from a silica formation was found to be the best. The area of pipe cleaned and painted per 8-hr. shift averaged 550 sq.ft. or 25 lin. ft.

Paint protection for the cleaned pipe interior was given in the application of two coats of red lead first by bristle brushes, then by paint spray. The first coat was allowed to dry and harden for a week before the second coat was applied. After applying the first coat on a portion of the job inspection showed that the paint was not reaching the deeper pits in the pipe, so after an hour had elapsed after the first coat was applied workmen went over the painted portion and touched up places where air pockets under the paint had formed. When the work was about 50 per cent complete air brushes were substituted for hand brushes because of the greater progress thereby made possible.

An idea of the magnitude of the job can be gained by noting the quantities of paint ingredients used and the area covered: 12,300 lb. red lead; 300 lb. boiled linseed oil; 400 lb. litharge; 142,000 sq.ft. of surface cleaned and painted.

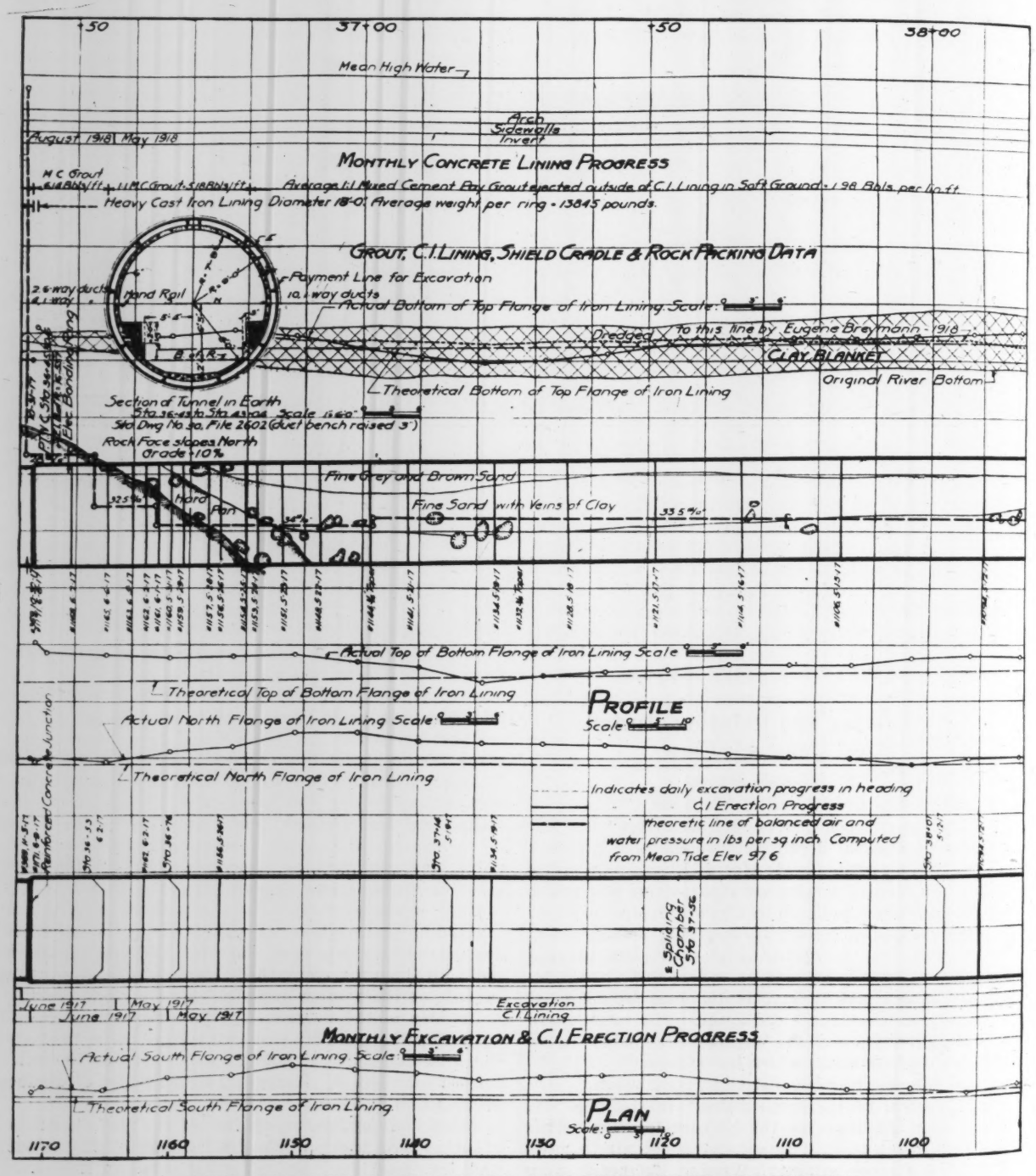
Aside from prolonging the life of the pipe, its restoration reduced friction losses in the pipe by 25 per cent and increased the total effective head at the power house by about 3 per cent.

Graphical Record of East River Tunnel Construction

THE ACCOMPANYING illustration is a typical section taken from record drawings showing details of the completed cast-iron tunnels of the New York subway system under the East River, as prepared under the direction of the chief engineer of the Transit Commission, Robert Ridgway. The daily and weekly iron-lining erection progress, character of material in heading, air pressures, clay blanket and final position of top, bottom and sides of the iron lining, referred to the theoretic, are indicated on the plan and profile. Other details of construction and progress are indi-

From Job and Office

Hints that Cut Cost and Time



TYPE SHEET OF COMPLETE RECORD: EAST RIVER TUNNEL CONSTRUCTION

From Job and Office

For Contractor and Engineer

cated by notes as required. The record also includes important data relating to grout, cast-iron lining, shield cradle, rock packing outside the cast-iron lining, and other pertinent details. Monthly excavation and concrete lining progress is also indicated diagrammatically.

The record drawings were prepared on rolls of cloth back cross-section paper, to a scale of 1 in. = 10 ft. Photostat prints, on a reduced scale, 14 in. x 18 in. in size, showing a length of 250 ft. of tunnel, were made from the original. About 60 prints were required for a complete set for each tunnel, and these were numbered and bound together with a key plan and profile showing the full length of tunnel.

These photostat prints make a convenient record for those interested in maintenance and in future construction.

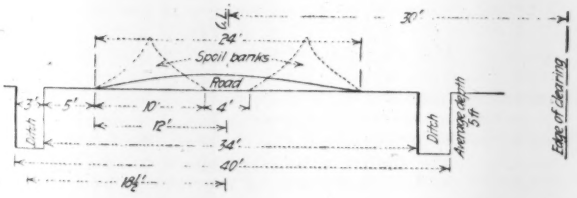
Roadway Built Up of Spoil From Drainage-Ditch Excavation

BY GEORGE C. LOVE,
Engineer, Newport News, Virginia

INCIDENTAL to some ditching for drainage of agricultural land in this vicinity, a road was wanted. The plan for building the road in connection with making drainage ditches is indicated in the accompanying drawing.

The ditches are cut by machine which makes a trench 36 in. wide and will cut to grade or to a maximum depth of 5.5 ft. In this work the average depth of cutting is about 5 ft.

A ditch is cut on each side of the roadway, the spoil banks being cast toward the center in each case. Afterward, the spoil banks are plowed and harrowed down toward the center of the roadway and shaped to the required crown by means of a road machine.



ROADWAY SECTION BETWEEN DRAINAGE DITCHES

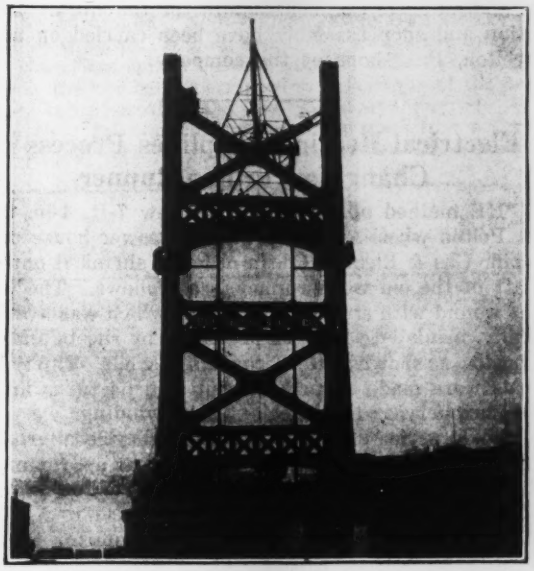
Experience with this particular soil has shown that the ditch banks do fall in in places but by giving the ditch ample depth in the original cutting and keeping blocked places clear, the ground water level of the land is lowered to a satisfactory point.

The material from the ditches as mixed by the trench machine is a reasonably satisfactory mixture of sand and clay for the crown of the roadway. The machine with two men has cut as much at 1,400 ft. of trench in 8 hours.

Special Creeper Traveler Used in Erecting Bridge Towers

BY CHARLES CARSWELL
Delaware River Bridge Joint Commission, Philadelphia

A "CREEPER traveler" specially designed is being used in the erection of the main towers of the Delaware River bridge connecting Philadelphia and Camden. As shown on the accompanying photograph, this creeper consists of an A-frame with braced stiff-legs and a single derrick boom 85 ft. long. The creeper is supported on two vertical guide beams made of rolled I-beams, 26 in. by 160 lb. in section, and bolted to the tower bracing at the distance of 20 ft. on each side of the center line of the tower. The traveler is raised to its successive positions by sliding along these guide beams. Only six different positions of the creeper are required for erection of the tower to the full height of 347 ft. above the masonry of the pier.



TRAVELLER ERECTING SUSPENSION BRIDGE TOWER

Power for operating the derrick boom and for moving the creeper is transmitted through cables from steam engines of especially sturdy construction located on the piers. Cables of sufficient length to handle erection to the tops of the towers were provided at the start of the work. Two drums are used for this length of wire. As the erection advances to the upper portions of the tower, where the sections to be handled are lighter, two parts of the main falls are taken out. The lengths of cables thus secured help to compensate for the added length required for increased height to the creeper. For hoisting the lighter sections, the two drums can be used simultaneously, thus securing greater speed.

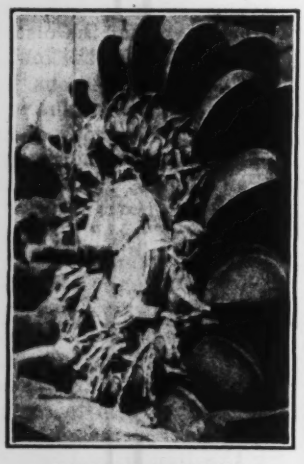
The towers are constructed of special "silicon" steel, which has a yield point of 45,000 lb. per square inch and tensile strength of 80,000 to 95,000 lb. per square inch. Each tower consists of two main legs which are of cellular construction, and are connected together by diagonal and horizontal bracing. The cables will be fixed at the tops of the towers on cast-steel saddle-

blocks, and changes in the cable length will be accommodated by deflection of the towers. These deflections may reach a maximum of 20 in. from the initial position. The use of the special grade "silicon" steel was economical because of these deflections and of the heavy weight of the cables and suspended structure that are supported by the towers. Fabrication work required a high degree of precision. The sections were all assembled at the shops in their respective positions for the reaming of connections to adjoining pieces, except certain vertical splices in the tower legs, which have holes left sub-punched and are being reamed in the field.

The towers are being fabricated and erected by the Bethlehem Steel Co., contractors for the work. Fabrication and shop assembly have been carried on at the Steelton, Pa., shops of the company.

Electrical Heating Simplifies Process of Changing Turbine Runner

THE method of expanding the new 7-ft. 4-in. diam. Pelton wheel at the Spring Gap power house of the Pacific Gas & Electric Co. in order to shrink it onto the shaft of the old worn runner is as follows. The wheel was wound with stranded bare wire which was available locally, insulated wherever necessary by sheets and tape asbestos, as shown in the accompanying cut. Thirty-nine turns were made around the hub and 54 turns around the periphery of the wheel. These windings were connected in series and supplied with 60-cycle alternating current. The voltage across the coils was approximately 103 volts, the current varying from 135 to 150 amperes. During the process of heating the wheel it was suspended in a box in order to maintain as uniform a temperature as possible throughout. Thermometers located so as to register the temperatures at the rim, the hub, and the inside of the box showed that the hub temperature increased much more rapidly than the rim temperature. For this reason the current was applied at short intervals and the temperature of the wheel was raised gradually until it reached about 135 deg. C. In the meantime the shaft was packed in a box of ice in order to reduce its temperature and diameter. As a result of the heating of the wheel and the cooling of the shaft, the hub diameter was increased 0.015 in. and the diameter of the shaft was reduced 0.001 in. and when the wheel was applied to the shaft it was found that it could be pulled into place with two sets of block and tackle. The heating process required about 27 hours, but it is believed that with a more flexible control it would be possible to reduce this time considerably.



RUNNER SHOWING HEATING COILS

From Job and Office

Hints that Cut Cost and Time

Renewing Ballasted Decks on Timber Trestles

METHODS of renewing the decks of long single-track and double-track trestles of the Southern Pacific Ry. were described in a committee report presented at the recent annual meeting of the American Railway Bridge and Building Association, and the following is an abstract of this part of the report:

Great Salt Lake Trestle—This trestle is 78,415 ft. long, of which 15,810 ft. is double track, having spans of 15 ft. c. to c., with five-pile bents for single track and nine-pile bents for double track. The deck is composed of 30-ft. pipe stringers 8x17 in., and 3-in. pine deck planks, surfaced one side, covered with burlap-base roofing paper on which is spread 1 lb. of asphalt per square yard. The stringers are soaked in the salt water before being used but the planks are not treated in any way. Renewal is in progress and is expected to extend over about four years. A material yard is located at Lakeside, four miles from the trestle. Material in quantities sufficient to last one week is taken to the trestle and unloaded by work train and a locomotive crane which also loads the old material and removes it.

Ballast is removed along the outer edge of each side of the trestle; guard timbers are removed and the old ballast is wasted overboard. The deck planks are removed as fast as the ballast is taken off and the track is blocked up immediately by the same gang. Old timber 8x8x48 in. is used for blocking, placed under and parallel with the ties. A lever of 4x6-in. Oregon pine 14 ft. long with a 2-in. pipe roller attached 16 in. back from one end is used to pry up the deck planks. The roller serves as a heel for the lever and also facilitates moving it forward. Drift bolts in the stringers are pulled with a special bolt puller and two 15-ton jacks.

A framing gang measures the lengths of the stringers with a steel tape, numbering them to correspond to the numbers of the bents. This gang also bores the holes for drift bolts. The old stringers are removed and the new ones taken to place on a heavy push car which has a double A-frame with a beam across the top of the frames. Two light crabs are bolted to the A-frames and a single and double block on each side of the car completes the rig. Five of the old stringers are picked up and taken to the rear and unloaded alongside of the handrail. Then the derrick car is moved to the new stringers, where five are loaded and taken to the place where the old ones were removed. On account of the limited amount of space on the trestle new stringers are deposited ahead of the work and the old material in the rear.

The deck plank, roofing paper and asphalt are placed by another gang, which usually does the work in sections of approximately 150 ft. The tops of the stringers are given a coating of hot creosote oil and this is then covered by a strip of roof paper 13 in. wide before the remainder of the deck is placed. Asphalt is heated in sheet metal heaters which hold 1,000 lb. and are mounted on push car wheels.

Islais Creek Trestle, San Francisco—This double-track trestle is 4,116 ft. long including four steel girder spans over streets, the ballasted deck portion being in three sections aggregating 3,427 ft. It has framed bents of creosoted timber about 24 ft. high, each bent carried on eleven piles cut off at the water line. The deck consists of twenty-nine stringers 8x17 in. and 3-in. pine plank surfaced on one side, with a covering of heavy roofing paper and ½ lb. of asphalt per square yard. River gravel was used originally for ballast, but was replaced with crushed stone. Renewal work consists of putting in new creosoted stringers and planking.

From Job and Office

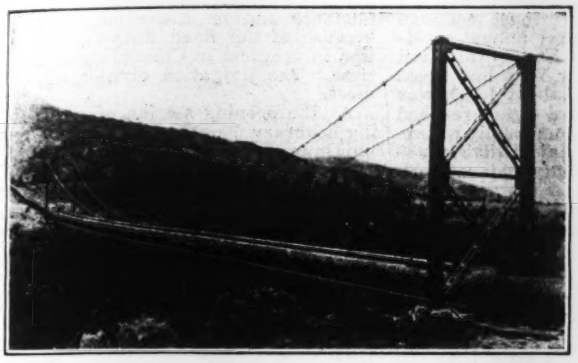
For Contractor and Engineer

A great variation in the lengths of stringers was found, as much as 10 in. in some panels, which called for very careful measurements of lengths. A sketch of the entire trestle was made on profile paper, indicating all the panels, all the stringers in each panel and the location of the joints on alternate caps. Four men were employed in taking measurements, two with steel tapes on each side. Where the variation in lengths between the two sides was one to three inches the average length between them was used. No notation was made to show the length until the officer in charge decided what length to use. With greater variation the difference was divided by ten; for example, if the difference between the two sides was 5 in., each stringer would vary ½ in. in length in that particular panel. No differences were made less than ½ in. If the exact variation was ¼ in. two stringers were ordered of the same length. About every 120 ft. the stringers were ordered 1 in. shorter than the actual measurement called for, to overcome any slight variation in framing, this space being filled with shims as required. The deck was 29 ft. wide and the deck planks were ordered in 14-ft. and 15-ft. lengths.

It was the original intention to do all the work under traffic, but as there was an average movement of over seventy trains daily during working hours this method was found impracticable after a few days' trial and it was decided to operate single track for about one-half the length of the trestle and do the work first on one track and then on the other. Necessary crossovers were installed and switchtenders placed at each end of the section with telephone service between. A temporary track was laid on the ground on each side of the trestle for the entire length and a locomotive crane with a 50-ft. boom was used in raising and placing material. Material for the new deck was all distributed at the right panels as it arrived alongside these temporary tracks. Ballast was wasted on the ground and new crushed rock ballast was used on the new deck. The old plank decking was cut between two stringers at the ends of the ties, the track raised 2 ft. on blocking and the balance of the old deck lifted, allowing the ballast to fall through to the ground.

A crane was used to lift the old stringers (drift bolts generally coming out of the caps with them) and to lower them to the ground. New stringers were then hoisted and landed on the caps. A gang then bolted them and a following gang placed and spiked the deck planks. The track was then lowered, the ties being permitted to rest on top of the decking and being raised as the new ballast was dumped. Altogether the track was changed to single track four different times as the work progressed from one section to another.

Suspension Bridge Carries Pipe Line



THE CROOK County Improvement District No. 1, near Redmond, Ore., is served by a 38-in. wood-stave pipe which brings water across the Crooked River Valley. Depth of the river canyon made construction of falsework for a bridge uneconomical, so it was decided that the cheapest structure to carry the pipe would be a suspension bridge of 224-ft. span. In the design of this bridge various plans were considered, both with and without horizontal and vertical stiffening trusses. The design finally adopted has no provision for vertical stiffening aside from the stiffening contributed by the wood-stave pipe. A light steel truss is provided for horizontal stiffening and is supplemented by guy cables. The pipe is carried by two 2½-in. cables, passing at either end of the span over structural steel towers 24 ft. high and carrying the bridge floor on ⅝-in. hangers 8 ft. apart. The lateral system is built up of angles supported on these hangers and in turn supports the pipe cradles. The guys consist of ⅝-in. stranded cables connected by clevices and turn-buckles to the lateral truss. Total load on the structure is 430 lb. per linear foot. The wood-stave pipe siphon which crosses this valley has a maximum head of 50 ft. and a diameter of 38 in., except in that portion which is supported on the bridge. Here the diameter is reduced to 30 in. in order to reduce the load. The bridge and the entire project for the improvement district were designed and constructed by Baar & Cunningham, consulting engineers, Portland, Ore. The contractor for the bridge was the Inland Construction Co., Portland, Ore.

Job and Office Notes

Mucking in Tunnels on the Pacific Gas & Electric Co.'s Pit River project in California is done by steam shovels operated by compressed air. Recently it was necessary to build a road at one of the tunnel portals and a steam shovel of the type used for mucking at the tunnel heading was assigned to the job. Instead of removing the air pipes and firing the boiler, as would ordinarily be done in outdoor work, a 3-in. air pipe was laid along the roadway to be excavated and the shovel with the same connections used in the tunnel was operated with compressed air. This plan, adopted as a matter of convenience and expediency, proved to be an economy as well because it saved the cost of the fireman that would have been required for operating by steam. This more than balanced the cost of laying and taking up the compressed air pipe line.

W. W. Monk, Foreman with the Shanghai, China, Waterworks Co., writes about the method of making cement joints for water mains, gas mains, etc. His method, he says, has been tested under the most severe conditions with which one has to contend in China.

"Some little time ago I had an occasion to cut out a small section of pipe which included a cement joint made by me about 10 years ago," says Mr. Monk. "On examination it was found practically as good as on the day it was put in, although it was laid only 2½ ft. under the surface of the road and was subject to heavy traffic during its 10 years of service.

"In making the cement joint the pipe is placed and spaced in the usual manner. A thin packing of the best dry spun yarn is used instead of oakum, as the spun yarn is free from oils and grease, which should be avoided. Portland cement, conforming to the specifications advocated by the British or American Society for Testing Materials, is used. The dry cement is run through a very fine sieve on a piece of board 18 in. square. Silver sand is also placed through the fine sieve and mixed with this cement making a 1:1 mixture. After this has been done it is moistened with just sufficient water to give it plasticity. This mixture is then tamped, starting at the bottom of the socket and working toward the top, into place by hand with a calking iron until the bell is about half full. It is then calked with heavy blows until the cement is heavily packed to the back of the socket. The process is continued until the socket is packed full. A small beading of neat cement in a plastic condition is then put round the whole of the joint using a small trowel. As soon as the cement has set backfilling of the excavated trench can be done, although it is advisable to leave the joint holes open and test the pipe line before filling completely in."

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Grade-Crossing Elimination Work in the towns of Salina and Dewitt in New York State on the Syracuse branch of the New York Central R.R. has been approved by the Public Service Commission and the state highway authorities, and work will start in the near future.

Replacement of the Present City Hall of Philadelphia by a new building on city-owned land at the end of the new parkway, facing the present city hall, has been proposed by Mayor Kendrick, who took office at the beginning of the year.

Work on the Plan for the consolidation of the railroads of the country into a number of large systems went into its final stages on Jan. 12, when the oral arguments before the Interstate Commerce Commission were concluded. The commission will now proceed with the preparation of its final plan of consolidation and its publication as required by the Transportation Act.

A Dinner-Meeting to Consider ways to care for the outpouring into New Jersey highways of the traffic from the New York-Jersey City vehicular tunnel beneath the Hudson River and from the Philadelphia-Camden bridge over the Delaware will be held at the Robert Treat Hotel, Newark, N. J., on Jan. 31 by the New Jersey State Chamber of Commerce.

The Fourth Annual New Jersey State Highway convention will be held in Trenton, Feb. 14-15, under the auspices of the New Jersey State Highway Association. Convention headquarters will be in the Stacy-Trent Hotel. Besides a number of interesting papers dealing with highway construction and maintenance, there will be a highway industries exhibit of materials and equipment.

A Midwinter Meeting of the Ohio State Highway Department, resident, division and assistant division engineers, has been called by L. A. Boulay, director of highways, for Feb. 7 at Columbus, when the highway program for the coming year will be discussed. The Ohio Engineering Society meets on Feb. 7 and 8 at Columbus and on the afternoon of Feb. 8 employees of the state highway department will have charge of the program.

Three Piers at Ocean Park, a beach resort of southern California, were destroyed on Jan. 6 by fire that originated in a restaurant. Press reports state that the losses on these piers, which were used chiefly for amusement purposes, were as follows: Pickering pleasure pier, $1,000,000; Lick's Dome pier, $750,000; Frazier pier, $250,000. Records of the U. S. Army Engineer Corps show the dimensions of these piers to have been as follows: Pickering, 600x300 ft.; Lick, 1,500x263 ft.; Frazier, 636 ft. long.

Civil Engineers' Meeting Marked by Active Technical Work

Divisions on Power, Highways, Sanitation and City Planning Hold Simultaneous Sessions—Research Committees Report Progress

Engineering News-Record Staff Report

Decided increase in technical activity as compared with previous meetings marked the seventy-first annual meeting of the American Society of Civil Engineers, held at New York last week. While the attendance, about 1,100, was smaller than the record figure reached last year, interest was unusually active. Three of the five technical divisions—on power, city planning and sanitary engineering—had sessions with animated discussion. The highway engineering division had two papers of great value but drew only small attendance and no discussion, probably because of the Road Builders' convention in progress in Chicago at the same time. The irrigation division did not meet.

At the opening session of the meeting honorary membership was conferred on Onward Bates, past president, and Desmond FitzGerald. As Mr. Bates was not able to attend, C. L. Strobel responded in his stead to the president's announcement of his election. Prizes for the best papers presented during the year were awarded, as announced in last week's issue (p. 129), after which President C. F. Loweth formally turned over his office to C. E. Grunsky, president-elect. Two important resolutions were passed by the meeting, one favoring adoption of the Mellon plan for income-tax reduction and one asking that engineering officials of the Public Health Service be given a commissioned status. The latter resolution was introduced at the instance of the sanitary engineering division and was recommended to the meeting by the Board of Direction. The sanitary engineering division further distinguished itself by instituting a new prize, the Rudolph Hering medal.

Committees Report

Fourteen technical committees presented progress reports at the first technical session of the meeting. Partial results were reported by one or two of them, while the others outlined their programs or told of work begun but not yet completed. The committee on highway engineering was discharged at its request. According to budgets presented by the several committees their work during the coming year will require about $26,000, but the Board of Direction was able to allot only about $12,000 of this.

Formation of a committee on research in cement was authorized by the Board. Another research committee, previously authorized, on engineering applications of timber, is shortly to be appointed. Prof. A. N. Talbot resigned the chairmanship of the committee on research and was succeeded by Dean A. Marston, in order to maintain close contact between the committee and the Board of Direction, Prof. Talbot's term as board member having expired.

Reports were submitted from the committee on friction of sewage sludge and from the sanitary engineering division's representative acting with a committee of the New Jersey Sewage Works Association on sewage studies being conducted at the Plainfield sewage-works by the New Jersey Agricultural Station and the New Jersey State Department of Health.

Diven Resigns as Water Works Association Secretary

At a meeting of the executive committee of the American Water Works Association on Jan. 18 the resignation of John M. Diven, secretary of the association, was accepted, effective Feb. 1. Temporarily, the duties of the secretary will be performed by W. K. Niesley, office assistant, 153 W. 71st St., under the direction of George W. Fuller, president of the association. Abel Wolman will continue to act as editor. Mr. Diven's recent appointment to his former office of superintendent of water-works, Troy, N. Y., was noted in these columns Jan. 3, p. 33.

Ambrose Swasey Is Awarded John Fritz Medal

The John Fritz gold medal, the highest honor bestowed by the engineering profession in this country, has been awarded for 1924 to Ambrose Swasey, engineer, manufacturer and philanthropist of Cleveland, Ohio. The award was made, according to the announcement, "for the building of great telescopes, the founding of the Engineering Foundation, and the invention and manufacture of fine machine tools, precision instruments and military and naval range finders."

The most notable of Mr. Swasey's many public benefactions was the establishment, through a gift of $500,000, of the Engineering Foundation as the joint research instrumentality of the four great national societies of civil, mining and metallurgical, mechanical, and electrical engineers.

The medal was established in 1902 in honor of John Fritz of Pittsburgh, pioneer in the American iron and steel industry, and is awarded annually for notable scientific or industrial achievement. Previous recipients have been Alexander Graham Bell, Gen. George W. Goethals, Guglielmo Marconi, Sir Robert Hadfield of London, and Eugene Schneider of Paris, head of the Creusot works.

Simultaneous sessions of the technical divisions occupied the entire second day of the meeting. Part of the evening was taken up by a dinner conference on engineering education, when the new investigation organized under the auspices of the Society for the Promotion of Engineering Education and directed by W. E. Wickenden was discussed. The principal proceedings of the technical divisions are reported on p. 156.

As a new departure, a conference of representatives of local sections was held in the course of the meeting. The conclusion was reached that the common problems of the sections in their own development and in their relation to the policies of the society at large warrant the establishment of a permanent organization. By adoption of rules of organization and procedure a foundation was laid for the continuing co-operation of the sections by regular conferences.

The social features of the meeting were as successful as usual. Besides the annual dinner-dance and smoker there was a boat excursion around New York harbor, on which the members were entertained by the city's Department of Plant and Structures. In the course of this trip the Staten Island municipal piers and the Hudson River vehicle tunnel construction were inspected. Air pressure was off the New York end of the tunnel, and the entire party was able to go through the cast-iron lined tube from the land shaft to the bulkheaded shield, which has reached the side of the river shaft. A separate excursion was made to a new 300-ton incinerator, a garbage disposal plant and a sewer tunnel and screening plant.

A fascinating address by Dr. Charles P. Berkey on an exploration trip in central Asia was the outstanding non-technical event of the meeting.

The gathering of engineers for the meeting was made the occasion for various reunions and group dinners, among them those of the Pennsylvania Engineers, the Thayer Society, and the Alumni of George Washington University.

Power Company's 1924 Budget Totals $26,288,000

The Southern California Edison Co. has announced its 1924 budget for the enlargement of its generating and distributing system as amounting to $26,288,000, which will be expended in the approximate ratio of 40 per cent for payrolls and 60 per cent for materials of all descriptions. The major items covered are:

Florence Lake Tunnel	$5,879,000
New generating units at Big Creek power houses Nos. 1 and 2 to be placed in operation in 1925: 25,000 kva. in No. 1; 16,000 kva. in No. 2	2,100,000
Diversion Dam and Florence Lake to 30,000 acre-ft. capacity	1,000,000
Huntington Lake-Shaver Tunnel	700,000
Distribution lines	5,943,700
Distribution substations	2,394,000
Transmission lines and stations	1,106,510
Total	$19,123,210

Other items which make up the total of the budget provide for substations, low-voltage lines and distribution requirements in general in the Los Angeles territory.

Appropriations for Reclamation in House Bill

Appropriations totaling nearly $10,000,000 chargeable to the Reclamation Fund are provided for in the appropriation bill now pending in the lower house of Congress. The items of the appropriation are as follows:

Salt River project (examination) $5,000; Yuma project, $765,000, which includes $250,000 for a power plant at a drop in the main canal whose cost is to be repaid by the Water Users Association in twelve annual installments; Orland project, $40,000; Grand Valley project, including Orchard Mesa division, $465,000; Uncompahgre project, $150,000; Boise project, $1,080,000; King Hill project, $40,000; Minidoka project, $380,000, none of which is to be expended on the American Falls reservoir; Huntley project, $150,000; Milk River project, $315,000; Sun River project, $150,000; Lower Yellowstone project, $95,000; North Platte project, $1,450,000; Newlands project, $155,000; Carlsbad project, $50,000; Rio Grande project, $706,000; Williston project, $100,000; Baker project (Ore.), unexpended balance reappropriated; Umatilla project, $940,000; Klamath project, $695,000; Belle Fourche project, $185,000; Strawberry Valley project, $40,000; Okanogan project, $70,000; Yakima project, $720,000; Riverton project, $650,000; Shoshone project, $475,000; Colorado River investigation, $25,000; miscellaneous projects, $50,000.

Heavy Crane Breaks Down Bridge

On Dec. 24 a bridge over Perry Creek, Sioux City, Iowa, was broken down by a 32-ton excavator which was being taken across it. City Engineer L. N. Hintgen gives the circumstances of the accident as follows:

"Perry Creek is being replaced by a concrete conduit on a length of about 1,800 ft., eliminating seven bridge crossings. On Dec. 23 it was decided to move a 32-ton bucket excavator from one end of the job to the other, crossing one of the bridges. These bridges are plate-girder structures, originally built from material assembled in 1890 to construct an elevated railway between Sioux City and Morningside. They comprise 48-in. plate girders on Z-bar columns, with floorbeams connected to the girders by gusset plates and wooden stringers flush with the floorbeams, carried in steel straps straddling the floorbeams. The decking was 3-in. plank carrying wood block pavement. In the course of time various defects developed in the floors of these bridges, including cracks in the floorbeam gusset plates. Some of these connecting plates had been reinforced a few years ago by hanging stirrup rods over the main girders and fastening them around the bottom flanges of the floorbeams. Because of the doubtful condition of the bridge floor on account of such defects, the contractor who was undertaking to move the excavator, C. F. Lytle Construction Co., was warned to ignore the wholesome appearance of the stringers and floorbeams. Nevertheless he attempted to take the excavator across the bridge, with the result that the structure collapsed and dropped the excavator into the creek. The failure was due to lack of strength of the reinforcing of the floorbeam connections, and to old cracks in the floorbeam gusset plates."

N. J. Chamber Discusses Transit Needs

N. Y. Transit Commission's Loop Plan Favored—Money Sought for Study of Needs

The transit needs of the New Jersey Metropolitan District with particular relation to better service between the New Jersey suburbs and New York City brought out an attendance of some two hundred people at a luncheon of the New Jersey State Chamber of Commerce in Newark on Jan. 10. A resolution was adopted urging the New Jersey legislature to appropriate money for the use of the Jersey Rapid Transit Commission, created by the legislature two years ago but as yet unprovided with funds.

B. H. Saunders, chairman of the commission just named and president of the City Planning Commission of Paterson, stated that the New Jersey Transit Commission favored the suggestion of the New York Transit Commission for a loop tunnel from the Battery or extreme lower end of Manhattan Island beneath the Hudson River to Jersey City, then northward beneath the various trunk line railways, except the West Shore, then eastward beneath the Hudson again to New York City, as outlined in more detail in a report just submitted to Governor Silzer of New Jersey. George McAneny, president, N. Y. Rapid Transit Commission, said that his commission was not in a position to endorse any specific plan for connections with New Jersey but stood for co-operation. The trunk line railways entering New York, he said, are choked with suburban traffic.

The Regional Co-operation Committee of the New Jersey State Chamber of Commerce circulated copies of a report it has made on transit facilities for the nine counties of Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union lying within forty miles of New York City and having a population of 2,350,000 in 1920 [Morris and Somerset counties, mentioned above, not included]. Waste of time because only two of the New Jersey railways take passengers to New York without change and, except for these two lines, practically no improvements in frequency or running time of trains to New York in the last twenty-five years were features of this report.

Herbert Swan, secretary of the North Jersey Rapid Transit Commission and specialist in city planning, New York City, said that interviews with officials of the various trunk-line railways concerned showed that not a single railway had worked out a plan for meeting these suburban traffic problems.

Highway Engineers Elect

The Highway Engineers Association of Missouri, meeting at Joplin Jan. 11, passed resolutions favoring the speeding up of Missouri's $60,000,000 state road program. The work of the state highway department and its chief engineer, B. H. Piepmeier, was also approved. Officers elected were: Charles H. Swift, Marshall, president; S. M. Rudder, Webster Groves, vice-president; C. W. Brown, assistant chief engineer of the state highway department, Jefferson City, re-elected secretary-treasurer. The association will meet in St. Louis in 1925.

Illinois Society Decides to Widen Its Field

Will Include Mechanical, Electrical and Mining Engineers—Various Subjects at Large Meeting

Expansion of its field by the organization of a new section to include mechanical, electrical and mining engineers was an important step taken at the annual meeting of the Illinois Society of Engineers held at Urbana, Ill., Jan. 9-11. This is the society's sixth section, the others (all devoted to civil engineering) being: (1) Land drainage, (2) roads and street paving, (3) sewerage and sewage disposal, (4) surveying and city planning, and (5) water supply. A strong list of papers presented at the initial meeting of the new section included: "Centralization of Power Development," by W. L. Abbott, chief operating engineer, Commonwealth Edison Co., Chicago; "Public Utilities and the Public," John F. Gilchrist, vice-president of the same company; "Engineering in Mine Development," C. W. Smith, chief engineer, Illinois Coal Co.; "Industrial and Decorative Illumination," C. E. Weitz, National Lamp Works; and "Fatigue of Metals," by Professor Herbert E. Moore.

The completion of a large road-building program in Illinois during 1923 was due to fall letting of contracts and winter stocking of materials, enabling work to be started early in the spring, according to an address by Frank D. Sheets, state superintendent of highways. Oiled earth roads which have proved satisfactory for secondary highways in Henry county were described by J. H. Reed, county superintendent of highways. From 2,500 to 4,000 gal. per mile are used and the cost averages 7c. per gallon for oil, freight and spreading.

Special Assessment Laws

Special assessment laws and procedure were discussed in three papers. J. B. Hittell, chief engineer of streets, Chicago, outlined a court decision which upheld certain legal objections and under which it will be necessary to give much greater detail in ordinance descriptions and estimates. In Mr. Hittell's opinion the laws need to be rewritten to prevent the delay of important public improvements by inconsequential objections. Other court decisions affecting the Illinois local improvement act were reviewed by Oscar C. Hoose, Bloomington, Ill. A paper by Paul E. Green, Chicago, explained the advantages of special assessments as compared with bond issues for financing improvement work, and he referred particularly to the recent change in the Illinois act by which the cost of engineering service is to be included in the estimate as a separate item, independent of the 6 per cent item for legal expenses.

Sewerage and sewage treatment were the subjects of a long list of papers, one of which by R. I. Randolph, Chicago, discussed the efficiency of different types of filters. Considerable attention was given to the Chicago situation, the sewage treatment works of the Chicago Sanitary District being described by F. W. Mohlman, chemist, while the dilution and treatment problems of the District were reviewed by Langdon Pearse, sanitary engineer. The latter stated that the District has now two programs: (1) Legislative, in regard to the question of amount of flow from Lake Michigan, (2) constructive, in planning and building extensive treatment works. The Society adopted a resolution approving the continuance of dilution up to a flow of 10,000 sec.-ft. with treatment for sewage beyond the amount which can be disposed of by such dilution.

Rival levee plans of the city and the State Waterway Department for the flood protection of Beardstown, on the Illinois River, were compared by A. D. Millard. The developments of engineering standards in municipal fire fighting facilities and of a standard schedule for rating cities in accordance with their fire protection, were reviewed by Clarence Goldsmith, assistant chief engineer of the National Board of Fire Underwriters. In 1923 this standard schedule had been applied to 4,534 cities.

Land surveying is always a popular subject and a controversy of surveyors over a difficult case of Chicago street and property lines was described by W. D. Jones, Chicago. That the topographic mapping of Illinois has covered 48 per cent of the area of the state was explained by M. M. Leighton, chief of the Illinois Geological Survey, in urging larger appropriations to expedite this work. Surveying instruction at the University of Illinois was described by C. K. Mathews, and a resolution was adopted recommending a summer camp in land surveying as an improvement upon methods now being employed.

The new president is E. E. R. Tratman, Wheaton, associate editor of *Engineering News-Record;* vice-president, A. L. Webster, civil engineer, Wheaton, Ill.; secretary, H. E. Babbitt, assistant professor of sanitary engineering, Urbana, Ill.

Approximately 200 members and visitors were present and the meeting ended with an inspection trip to the construction work on joint sewage works for Urbana and Champaign, the University stadium and the track elevation of the Illinois Central R.R.

The next annual meeting will be held at Chicago in January, 1925.

Gas in Air of Unventilated Liberty Tunnels

A traffic test of the new Liberty Tunnels in Pittsburgh was made on Jan. 12, to test the possibility of opening the tunnels to traffic before the ventilating plant is ready to operate. A. D. Neeld, engineer for the tunnels, opposed premature opening to traffic, but the county commissioners wished to put the tunnels to use as soon as possible.

A procession of some 200 automobiles was therefore allowed to pass through each of the two tunnels, and the resulting pollution of the air in the tunnels was determined by analysis by A. C. Fieldner, of the U. S. Bureau of Mines. The analyses showed 4½ to 10 parts of carbon monoxide in 10,000 parts of air. On this showing it was decided not to allow traffic through the tunnels until the ventilating system is in service, probably in May.

Three Power Companies Bid for Muscle Shoals

Still another offer for the government-owned property at Muscle Shoals has been received by the Secretary of War. This latest bid, made public Jan. 19, is from the Tennessee Electric Power Co., the Columbus Electric and Power Co., and the Alabama Power Co., and by its terms an operating power company with a working capital of $10,000,000 agrees to the following:

1. Lease of Dam No. 2 and its powerhouse, upon completion, for a term of 50 years, and lease of steam plant at Sheffield at an annual average rental of $2,000,000; the lease to begin when 100,000 hp. are made available by the government;

2. Maintenance at its expense of all Dam No. 2 properties, excepting the dam itself and the navigation locks, though power will be furnished the government free for their operation;

3. Construction of Dam No. 3 together with its locks and powerhouse whenever requested by the United States after completion of Dam No. 2, plans and specifications and construction cost to be the government's; the powerhouse to have a total installation of 250,000 hp.

4. Lease of the Dam No. 3 powerhouse, should it be constructed, for 50 years at an annual rental of 4 per cent of construction cost, though not to exceed $1,200,000 yearly, the lease to begin when 80,000 hp. are available;

5. Maintenance of all structures except the Dam No. 3 and its locks to be at the power company's expense, locks operation to be the same as in the case of Dam No. 2;

6. Agreement to purchase, if the government cares to sell, the steam plant at Muscle Shoals for $4,500,000;

7. Agreement that projects covered by licenses (issued in conformity to terms of the Water Power Act) shall be subject to recapture by the government; or that whenever the safety of the United States demands, it can operate all projects necessary for making explosives, nitrates or munitions;

8. Delivery, upon completion of No. 2 project, of 60,000 hp. for manufacture of fertilizer; and upon completion of No. 3 project 40,000 hp. additional;

9. Creation of a $1,000,000 fund for electrochemical research in the interest of agriculture and national defense, that sum to be paid by the power company to a board of five directors, one representative each to be named by the Secretaries of War, Agriculture and Commerce, any corporation manufacturing fertilizer for the government at Muscle Shoals, and the power company.

Dirigible Weathers Heavy Gale

Wrenched from her mooring mast at Lakehurst, N. J., during a 68-mile gale Jan. 16, the U. S. Navy dirigible, the "Shenandoah," returned in the teeth of the wind after having been driven by force of the storm northward along the New Jersey coast. As the Shenandoah left her mast her motors, started, gradually picked up power as she left the station. The enforced flight lasted from 6:52 p.m. Jan. 16 until shortly after 2 a.m. Jan. 17. The ship had been anchored to the mooring mast to give the crew training and to test pressures imposed under varying wind forces.

Poughkeepsie Bridge To Go Ahead

New York State last year appropriated $200,000 for preparation of plans for the Poughkeepsie bridge, the land being donated by property owners or contributed by the city of Poughkeepsie. Approval by the War Department of a Congressional bill to authorize the state to build the bridge leaves the state free to make appropriation this year for actual construction. A bill carrying appropriation for amount to be expended the coming year will be introduced shortly.

Bids Asked on Philadelphia Bridge Approach Piers

Contracts are being advertised by the Delaware River Bridge Joint Commission for construction of the approach piers on both sides of the river. The piers are to be of concrete and granite masonry, and will support the steelwork of the approach structures. Foundations of the piers will be spread footings on gravel, and where necessary, reinforced-concrete piles will be driven. The granite work will be facing on the piers and will be of the "rock-faced" ashlar type, except for the top coping which will be bush-hammered. The piers will rise to from 3 to 10 ft. above the future finished grade of the ground surface.

Bids for the work are being asked in two forms, the first for the work on either approach without regard to the other approach, and the second, for the work on each, dependent upon the award of the other contract to the same bidder. The contracts include the making of test boring to determine the character of the sub-surface strata.

Bids for the approach piers will be opened on Feb. 13.

Final Report on Columbia Basin Project Expected Soon

The final report on the proposed Columbia Basin irrigation project will be submitted to Congress about the middle of March by the Secretary of the Interior. The commission having charge of the investigation is composed of Assistant Secretary of the Interior Francis M. Goodwin, Commissioner D. W. Davis of the Reclamation Bureau, and F. E. Weymouth, chief engineer of the Reclamation Bureau.

Information has been given out by Chairman Goodwin of the commission to the effect that the field investigations have been completed. The office maintained at Spokane, Washington, will be closed the middle of February after final data for the report have been compiled. At the present time the soil survey and geological survey have been finished. Studies of the water supply of the entire Columbia River Basin have also been tabulated and will be submitted to the commission at an early date.

At present the force of engineers conducting the field work is busy preparing estimates of costs, profiles for dams and the necessary canal systems. All of this information is expected to be in the hands of the commission headed by Assistant Secretary Goodwin by March 1, after which the final report will be prepared and submitted to Congress about the fifteenth of March.

Record Attendance at Meeting of N. Y. Section A.W.W.A.

Much the largest meeting ever held by the New York Section of the American Water Works Association took place in New York City on Jan. 17 as the result of an invitation extended to the members of the Sanitary Engineering Division of the American Society of Civil Engineers to join in the luncheon and listen to the subsequent address by George W. Fuller, consulting engineer, New York City, on "The Practice of Double Filtration of Water in Europe." An even 200 members and guests were present.

Mr. Fuller reviewed briefly the use of preliminary filters followed by slow sand filters in the water-works of Zurich, Switzerland; Berlin and Hamburg and vicinity in Germany; Schiedan, Holland; and at London, Edinburgh, and other places in Great Britain. An abstract of the paper will appear in a later issue.

Engineer Committee Organized To Study Colorado River

A committee composed of five engineers, four of whom are in the service of the government and the fifth an outside engineer, is being organized by Secretary of the Interior Work for the purpose of advising on a definite plan for the control of floods on the Colorado River, the development of its water power and the storage of water for irrigation of arid lands in the lower Colorado River basin.

The proposed personnel of the committee includes one representative each from the following services: War Department, Reclamation Bureau, Geological Survey and Federal Power Commission; together with another engineer, providing he can be found, not connected with the government. Secretary Work has appointed F. E. Weymouth, chief engineer of the Reclamation Bureau, to serve on the committee as a representative of the Reclamation Bureau. Herman Stabler was named to represent the Geological Survey, and Col. William. Kelly to represent the Federal Power Commission.

Ontario Takes Formal Step in Developing St. Lawrence Power

The Ontario government has taken the first formal step towards the development of the water power of the St. Lawrence River. On Jan. 15 it authorized the Ontario Hydro-Electric Power Commision to apply to the Dominion government for permision to undertake the project. The Commission will place before the Dominion authorities the immediate need of definite action for negotiating with the United States to obtain a treaty governing the distribution of the waters.

The basis on which the Ontario government proposes that the work should be undertaken is that the Dominion would contribute approximately $7,500,000, the province of Ontario $30,000,000, and the United States $37,500,000 as respective shares in the enterprise. The amount asked from the Dominion is the estimated cost of a dam which it will be necessary to construct in the vicinity of Morrisburg not for power generation but to maintain the level of the water for navigation.

Executive Board of Engineering Council Named

Representatives of national engineering organizations on the Executive Board of the American Engineering Council for the coming year have been chosen as follows:

American Society of Mechanical Engineers, Dean M. E. Cooley, University of Michigan; Dean A. M. Greene, Jr., Princeton; F. K. Copeland, Chicago; L. P. Alford, Fred R. Low and Major Fred J. Miller, New York; American Institute of Electrical Engineers, Col. J. H. Finney, Washington; Prof. Dugald C. Jackson, Massachusetts Institute of Technology; C. E. Skinner, Pittsburgh; F. B. Jewett and L. F. Morehouse, New York.

M. G. Lloyd, chief of the Safety Section of the U. S. Bureau of Standards, will represent the American Society of Safety Engineers; S. H. McCrory, U. S. Bureau of Public Roads, the American Society of Agricultural Engineers, and H. E. Howe, Washington, the American Institute of Chemical Engineers.

For purposes of organization the country has been divided into eight districts, which will be represented on the Executive Board by the following:

District 1, Hubert E. Collins, Utica, N. Y.; District 2, W. H. Hoyt, Duluth, Minn.; District 3, C. R. Gow, Boston; District 4, Arthur R. Cruse, Philadelphia; District 5, John S. Barelli, New Orleans; District 6, C. M. Buck, Topeka, Kan.; District 7, O. H. Koch, Dallas, Texas; and District 8, J. C. Ralston, Spokane, Wash.

The St. Paul Engineers Club has been admitted to membership.

Chicago Sanitary District 1924 Budget

The 1924 budget of the Sanitary District of Chicago totals $38,000,000. This is an outside figure and not at all likely to be reached either in expenditure or obligation. In the budget is $3,500,000 for expenditure by the government in regulating works for the Great Lakes, $3,000,000 for the North Side intercepting sewer leading north to the North Side sewage treatment works, for which substructure contracts have been let. For this contract $2,500,000 is apportioned, $1,000,000 for valves, pipe specials and miscellaneous equipment to be set in this structure and $500,000 for a long cast-iron pipe carrying sludge several miles to a less populated area south. For a 4½-mile highway along the North Shore Channel, advertised for several years ago, $800,000 is allowed. For sewage works at West Hammond is an item of $200,000. For an industrial wastes treatment plant at the stock yard is set aside, in case an agreement with the packers can be arrived at, $500,000, and an equal amount for an intercepter. For continuing the Thirty-ninth Street conduit extension (under contract), $1,764,000. For five bridges and a subway, $3,500,000. For remodeling Lawrence Ave. pumping station, $400,000; for the Racine Ave. pumping station, $500,000; completing Ninety-fifth St. pumping station, $680,000; new pumping equipment at Thirty-ninth St. pumping station, $250,000; dredging the Calumet River, $500,000, and concrete walls for the main channel, $500,000; Calumet intercepter and extensions, $680,000.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 11-13, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-24, 1924.

The Dayton, Ohio, Section, American Society of Civil Engineers, held its monthly meeting Jan. 14, at which Philip C. Nash, dean of Antioch College, Yellow Springs, Ohio, gave a talk on technical education and the Antioch plan. Letters have been sent by the section to its representatives and senators in Congress urging the enactment of legislation for the appointment of a commission to investigate the St. Lawrence River improvement.

The Providence, R. I., Engineering Society, together with affiliated local sections of national societies, will hold its annual banquet Feb. 5 at the Providence-Biltmore Hotel. Speakers will be: Merle Thorpe, editor of *The Nation's Business*, subject, "Know America;" Dr. George Otis Smith, director of the U. S. Geological Survey, subject, "Foundations of Industry;" and Captain Irving O'Hay, humorist.

The Associated General Contractors of America, Northwest Branch with headquarters in Minneapolis, Minn., will hold its annual convention in Minneapolis Jan. 28-30, 1924. The proceedings of the national convention of the Associated General Contractors of America, which met in Chicago Jan. 21-24, will be discussed and an address will be given by the national president of the association, F. L. Cranford, of F. L. Cranford, Inc., Brooklyn, N. Y.

The Montreal Branch of the Engineering Institute of Canada held its annual meeting Dec. 29, at which the following officers were elected: Chairman, O. O. Lefebvre; vice-chairman, J. S. Busfield.

The Texas Section, American Society of Civil Engineers, will hold its annual spring meeting on March 20, 21 and 22, at Brownsville. The program will include papers on irrigation, railway terminals and stream measurements. Trips of inspection will be made over some of the noteworthy irrigation projects in the Rio Grande Valley.

The Washington Irrigation Institute, at its annual meeting in Yakima, Wash., recently, elected Joseph Jacobs, consulting reclamation engineer of Seattle, president. The Institute went on record unanimously in favor of assisting in co-operative marketing organization movements. It opposed any suggestion of repudiation of financial obligation to the government by farmers on federal reclamation projects, but recommended extensions of time in payment in cases where relief is justified.

Personal Notes

ELROD ENGINEERING CO., of Dallas, Texas, has opened a branch office in the Mills-Fraser Bldg., Santa Monica, Calif., with HENRY E. ELROD in charge. The company has been awarded the engineering and supervision of a new water supply and distribution system for the city of Santa Monica, for which $1,000,000 was voted Dec. 4, 1923.

JOHN C. WATTS, formerly engineer of the Harbor and Dock Commission of Troy, N. Y., has been appointed city engineer of Troy, succeeding ALFRED E. ROCHE who for twelve years had been chief engineer of public works and of the water bureau. Mr. Watts was formerly deputy engineer under Mr. Roche. JOHN FLYNN has been appointed engineer of the Harbor and Dock Commission.

R. M. GUERRY, whose new address in Saranac, N. Y., and who for the past three years has been field engineer for the Parklap Construction Corporation, is now field engineer for the International Paper Co. on construction work on their new hydro-electric development in the Adirondack Mountains.

A. C. CRIDDLE, superintendent of construction work at the west portal of the Moffat tunnel, Colo., has resigned. William Fowler, formerly superintendent for the Construction Co. of North America and recently employed on the Hetch Hetchy project in California, will take charge of the tunnel work at the west portal.

LOUIS W. BRUCK, who on Jan. 1 completed a three-year term on the city plan commission of Indianapolis, Ind., has been appointed by the commission as consultant on traffic and transportation. The commission expects soon to have the report of J. Rowland Bibbins, of Washington, who was engaged some time ago to make a survey of traffic conditions. Mr. Bruck will carry out the recommendations of the commission relative to traffic and transportation, and plans will be made to develop a comprehensive, city-wide major thoroughfare plan for Indianapolis.

F. B. MALTBY has permanently located near Norristown, Pa., after 38 years of service in charge of construction work on various projects. Since 1922 Mr. Maltby has been resident engineer with the United Hudson Electric Corp. of Poughkeepsie, N. Y., in charge of the construction of a hydro-electric power plant near Rifton, N. Y.

EARLE B. MOSS was appointed city engineer of Niagara Falls, N. Y., effective Jan. 1, 1924, after having for the past three years been employed by the city of Niagara Falls as appraiser in the bureau of assessment and taxation.

ARTHUR MCMULLEN CO., New York, announces the organization of Arthur McMullen & Senior Co., an Illinois corporation, with offices in the Harris Trust Bldg., 111 W. Monroe St., Chicago. The new company is formed to facilitate the execution of the company's contracts for engineering construction in the Middle West; the company specializes in harbor and railroad construction and foundation work.

GERARD H. MATTHES, consulting engineer of Los Angeles, and for many years with the U. S. Geological Survey, has joined the Fairchild Aerial Camera Corporation of New York City, and will be located in New York.

P. M. SAUDER, assistant manager of the Lethbridge Northern Irrigation District, has been appointed manager to succeed Major H. B. MUCKLESTON, who has resigned. Mr. Sauder is a graduate of the University of Toronto and has been in the employ of the Dominion government for sixteen years, working his way up from draftsman to chief engineer in charge of hydrometric surveys in Alberta and Saskatchewan. In 1920 he was appointed divisional engineer for the Lethbridge district and last July became assistant manager.

Prof. HORACE R. THAYER, of Scranton, Pa., has just been elected an honorary member of the Authors Club of Pittsburgh, Pa. Professor Thayer is a graduate of Massachusetts Institute of Technology and Lehigh University. He was for some time an instructor in civil engineering in the latter institution and from 1906 until recently was professor of structural design in Carnegie Institute of Technology, Pittsburgh, and consulting engineer in Pittsburgh. Among his writings are: "Elements of Structural Design," "Design of Simple Structures," and "Skew Structural Work."

R. V. MEIKLE has been appointed chief engineer for the Merced Irrigation District, succeeding R. C. STARRETT, who resigned. A. J. WILEY will act as consulting engineer, THEBO, STARR & ANDERTON, who have been consulting engineers on the project, having also resigned. Both Mr. Meikle and Mr. Wiley were connected with the construction of the Don Pedro dam of the Modesto and Turlock irrigation districts in Stanislaus County, California.

G. H. HICKS, valuation and property engineer, Northwestern Pacific R.R., with headquarters at San Francisco, has been appointed chief engineer in charge of all engineering work in connection with construction, maintenance property rights and valuation. Mr. Hicks began his railroad career with the Chicago, Milwaukee & St. Paul R.R. Co. in 1902; has served both with the Western Pacific and Southern Pacific companies; and has been in the employ of the Northwestern Pacific R.R. Co. since 1912. During his service with that road he has filled successively the positions of assistant valuation engineer, principal assistant engineer, and valuation and property engineer. In the capacity of chief engineer he succeeds J. W. Williams who some time ago resigned to become chief engineer of the Western Pacific R.R.

A. E. GORMAN, sanitary engineer for the U. S. Public Health Service in charge of water supply for the Great Lakes District, has been appointed sanitary engineer to the Chicago Department of Health. His principal duties are to control the addition of chlorine to the water supply and coordinate in this respect the functions of the Health Department and the Bureau of Engineering which operates the water-works. The position to which Mr. Gorman has been appointed has grown out of the November typhoid epidemic in the Hyde Park district.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Road Show Draws Record Crowd to Exhibits of More Than 200 Manufacturers

Impressive Display of Machinery and Materials Staged by American Road Builders' Association in Chicago

Engineering News-Record Staff Report

THROUGH the medium of the Good Roads Show held at Chicago last week in conjunction with the 21st annual convention of the American Road Builders' Association, the great industrial organization behind the nation's billion-dollar-a-year road-building program gave an impressive demonstration of its size and scope. Machinery and materials from the plants of 227 exhibitors filled the Coliseum, the Annex and two adjoining structures. Even under these conditions Charles M. Upham, convention and show manager, could have disposed of additional exhibit areas if it had been physically possible to provide them.

This year's show established new records not only in the number and diversity of road-building products on display, but also in the volume and character of the attendance—the all important factor from the manufacturers' point of view. The idly curious visitor and the souvenir collector constituted an insignificant proportion of the thousands who flocked to the show last week. Scores of manufacturers confirmed the observation of *Engineering News-Record's* representatives that the exhibit drew an attendance of contractors, engineers and public officials representing a buying power far exceeding that of former years. This is not a casual impression; it is backed up with the solid evidence of orders placed and inquiries received. As one equipment manufacturer expressed it: "This year's show has been the best business investment we have ever made."

By resolution of the directors of the American Road Builders' Association last week, Chicago is chosen, provisionally, as the scene of next year's Road Show. The choice is contingent upon the ability of the association to secure "satisfactory hotel accommodations and suitable quarters for the show."

The outstanding features of the show, judged by the number and diversity of machines on display, were in the fields of earth excavation, concrete mixing and placing, material handling, mechanical transport and power. A survey of the hundreds of machines in the show offers opportunity for a few generalizations on the trend of development:

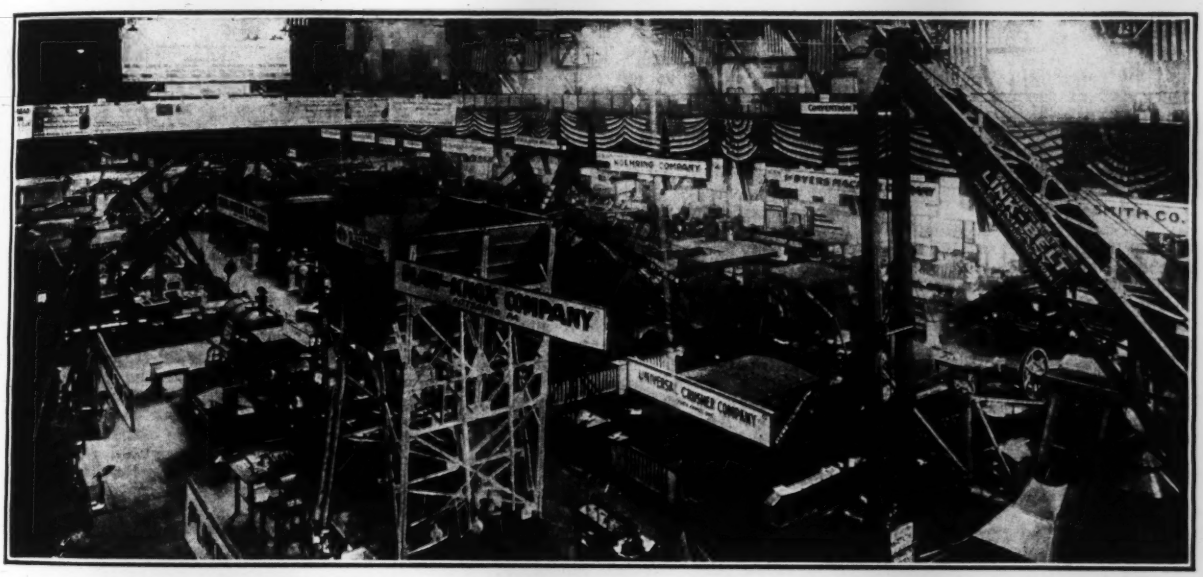
Progress has taken the form of improvements in mechanical details rather than in radical changes of type. Among the novelties, however, were a new back-action trench pull-shovel, with dipper working toward, instead of away from, the machine; a large tractor-operated snow plow equipped with revolving vanes; highway guard rail of wire mesh; a shovel attachment with telescopic boom and skimmer-scoop for a light crane; a ditcher with a vertical boom for shallow trenches; a new model of heavy excavator for trenches 40 in. wide and 18 ft. deep; a complete portable screening, crushing and loading plant; a shovel operated by tractor engine power; a bucket loader with new rotary cylinder feeding device.

Gasoline engines were the predominating power equipment, although one shovel manufacturer is using a Diesel engine as standard equipment for a ¾-yd. machine. Even on some of the lighter equipment the trend is toward the use of four-cylinder engines and on single-cylinder power units of small capacity one manufacturer has adopted as standard magneto ignition, instead of battery and coils.

Mobility is being secured by a quite general use of crawler tread mountings for the heavier types of equipment and by rubber-tired wheels for the smaller concrete mixers and portable compressors or pumps. Designers of road-building plant are adopting forced feed lubrication in place of grease cups. Another marked trend is the widening application of alloy steel not only for increasing the durability of parts subjected to heavy wear or great strain, but also for decreasing weight.

In the concrete mixer field attention has been concentrated on speeding up the operations of loading and discharging, improving the batch supply of water with automatic valves and tanks and preventing accidents by the use of skip guards. Manufacturers are introducing into some of their smaller models of mixers features associated generally with the larger types of machines; one maker has equipped a 4-S mixer with power loader. On the 21-E pavers designers have provided the skips with an extremely steep angle of discharge, facilitating the rapid entry of materials into the drum.

The motorization of the road contractor's equipment has had its effect on the design of blade graders, trailers and other tools hauled by tractors. Grader frames have been strengthened for tractor operation. Steel has replaced wood in the tongues of these machines and offset hitches have been provided to enable the tractor to operate along the middle of the road while the grader travels at one side.



HEAVY EQUIPMENT ON MAIN FLOOR OF COLISEUM DURING ROAD SHOW (LOOKING NORTH FROM BALCONY)

Tractors were in evidence, not only for haulage but as power plants for other types of equipment, such as road rollers, portable compressors, bucket loaders and light power shovels.

The foregoing notes cover briefly the general features of the more important types of equipment exhibited in the Coliseum last week. Further details on improvements in individual machines, grouped according to types, will be found in the following paragraphs:

Excavating Machinery

Road Graders

DESIGNED for tractor operation the Russell Super-Mogul grader is equipped with a 12-ft. blade, the depth of which, this year, has been increased to 24 in. Improved mechanism facilitates the rapid adjustment of the blades and a scarifier has been built into the machine. The feature of the Havelock road maintainer is its four multiple blades adjustable to fit the contour of the road; a master-lift permits all blades to be raised in one operation.

On the 8-ft. grader shown by Austin-Western the wheels were equipped with rubber tires; a new steel, instead of wood tongue and an offset hitch have been provided for tractor operation. For use with the Pup roller a new blade of increased height was designed with dual control, making it possible to work either end of the blade above or below the other.

For the Adams leading-wheel grader back-sloper attachments are now available as standard equipment for the 7, 8, 10 and 12-ft. machines; the frames of these graders are now made of high-carbon steel and the blades are fitted with a manganese steel cutting edge. In the Galion grader with 10-ft. blade a scarifier with vanadium teeth is mounted just ahead of the blade; the company's machine at the show had rubber-tired wheels.

The Avery company's one-man power-lift "road-razer" is a self-contained unit with tractor power plant and blade in one machine; the blade is made in three sections to fit the crown of the road. Other self-contained power-operated units were the Wehr grader combined with Fordson tractor, and the Huber maintainer with a three-section blade giving a cut of 9½ ft. The latest model Baker Maney self-loading scraper has had its capacity increased from 1 to 1½ yards; this machine is fitted with a cast steel tongue for tractor operation; the bolster is made up of three sections of cast steel, the whole outfit being designed for heavy pull. The Gilbert Mfg. Co. showed a Fordson-operated combined grader and scarifier equipped with rubber-tired wheels.

Power Shovels

One of the widely inclusive exhibits covered the field of power shovels in which eleven manufacturers were represented. Most of these machines were the ¾-yd. revolving type mounted on crawler traction. The novelties, this year, included a crawler-mounted trench pull-shovel, exhibited by the Northwest Engineering Co.; this is a back-action machine with the dipper working toward, instead of away from, the outfit. Buckets are provided in widths of from 17 to 48 in. and the working depth is from 16 to 18 ft.

Another innovation was the Insley one-man earth mover in which the power is supplied by a Fordson tractor engine. When used as a shovel this equipment handles ½-y. dipper; the crane attachment handles a ¼-yd. clamshell. This machine was in operation in a lot near the Coliseum.

Another newcomer in the light shovel class was the Byers-Fogarty attachment for the Byers crane; it differs from the ordinary skimmer scoop in that the ½-yd. bucket is mounted on the end of a telescopic boom so that the outfit may be worked directly into an earth bank. This machine also was in operation on a lot near the show.

Among the ¾-yd. shovels Osgood showed a machine with optional three- or four-lever control and forced-feed lubrication of the crawlers; a recent change in the traction design provides for driving tumblers with flat instead of round faces. Osgood shovels designed for compressed-air operation are to be employed on the Moffat tunnel work in Colorado. The Bucyrus Co. featured the equipment of its ¾-yd. shovel with a Diesel engine for which the fuel cost was claimed to be less than $1 per 8 hour day. For the Thew shovel emphasis was placed on its convertibility to clamshell work; the traction has two speeds and the crawlers have a single-girder mounting. Two speeds of traction also are provided in the Koehring shovel, this feature facilitating the steering operations; this outfit is convertible into a crane and has two hoist line speeds, one for clamshell and the other for dragline.

A feature of the Pawling & Harnischfeger shovel is a new traction brake with which either set of crawlers may be locked; manganese chrome steel is used for the crank shaft of this machine and the crawlers are provided with forced-feed lubrication instead of grease cups. For quarry work the company provides a solid manganese dipper. The Erie ¾-yd. revolving shovel shown was a steam-operated machine on lubricated treads with a dipper front consisting of a manganese steel casting for long wear. A new model of shovel-crane was shown by the Austin Machinery Corp. The Marion Steam Shovel Co. by means of a series of photographs, demonstrated the types and uses of its machines on a variety of construction operations.

Trench Excavators

Equipped with a 75-hp. gasoline engine the newest model of Parsons trench excavator is designed for a cut 40 in. wide and 18 ft. deep; a feature of this machine is the assembly of the main mechanism as a unit in a cast steel frame. The digging boom is held down to its work by an improved suspension and crowding device.

On the Barber-Greene vertical-boom ditcher, for trenches 18 in. wide and 4 ft. deep, the new feature is a mechanical overload release in the form of a spring clutch on the driving sprocket.

The Buckeye Traction Ditcher Co. featured its latest model of backfiller and the Austin Machinery Corp. included one of its large trenching machines as part of an extensive exhibit.

Material Handling Equipment

Cranes

CRANES of two general types were shown at the Coliseum, the first including the heavy locomotive models mounted on crawlers or railroad trucks and the second the light cranes carried by motor trucks. In the first category were the Link-Belt, Brownhoist, and Austin models in addition to those convertible from power shovels already described. The Link-Belt machine, with a 40-ft. boom, was mounted on chrome steel crawlers; one of its features is cut gear drives on the lower frame, fully inclosed in oil-tight casings.

An eight-wheel railroad truck mounting was shown on the Brownhoist crane with 1-yd. bucket operated from a 40-ft. boom; this machine is steam operated. Full caterpillar mountings were a feature of the new model of Byers full-circle, 10-ton crane equipped with chrome steel shafts and gearing.

Among the light mobile cranes was the Universal, mounted on a 5-ton motor-truck chassis and equipped with 24-ft. boom and ½-yd. bucket. This is a full circle machine equipped with jacks to take the load off the truck springs when the outfit is in operation. It traveled from Cleveland, 400 miles, to reach the show. Another mobile unit was the Byers "truckrane" mounted on a Mack chassis; it is designed for operating a ½-yd. clamshell.

Loaders and Conveyors

In the field of elevating bucket loaders an innovation was the Austin continuous rotary loader, the feature of which is a feeding device consisting of a pair of wide cylinders on which are mounted, spirally, four sets of wings or blades which supply a continuous flow of materials to the bucket. With this device the machine makes a 7-ft. cut and material is prevented from falling back of the loading device. In addition to a larger model of loader, a Haiss machine was shown equipped with a Fordson tractor power plant carried on a caterpillar mounting.

In the Link-Belt Co.'s new Grizzly loader, with a capacity of 40 cu.ft. per minute, the features are a swiveling mechanism for a 20-ft. cut, crawler tread mounting, and the use of solid cast steel construction for the lower base.

The Barber-Greene loader shown was one of the company's standard crawler-mounted models equipped with measuring hopper and rotating disc feeders.

Concreting Equipment

Mixers

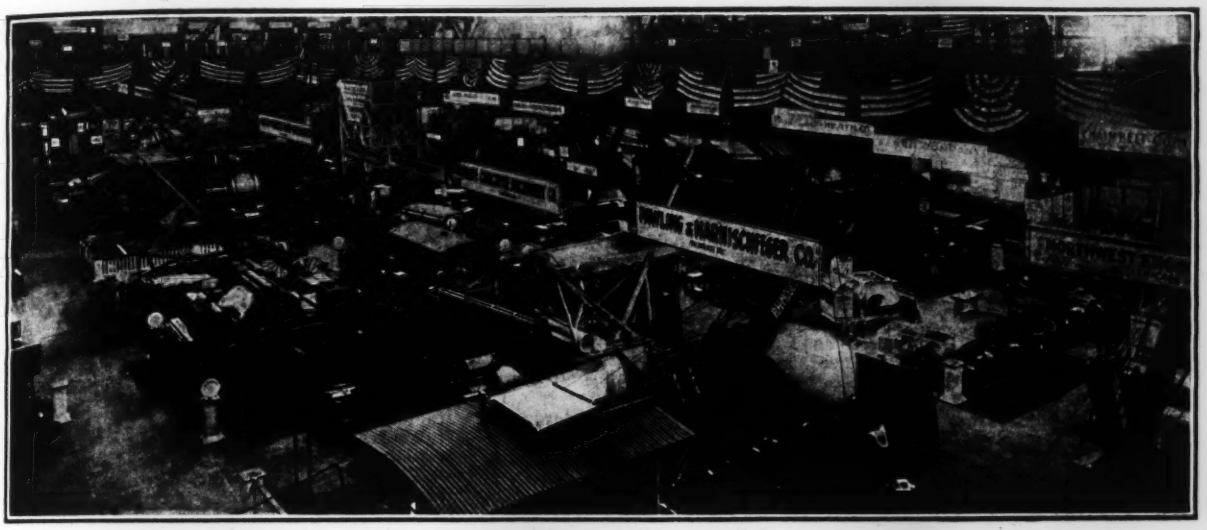
ABOUT a dozen manufacturers of concrete mixers exhibited their machines, the larger models being of the 21-E size mounted on crawler treads. Among them were the Ransome, Koehring, Smith, Chain Belt and Foote. On the latest Ransome paver the points featured are the use of oversize, high-carbon steel shafting, rapid loading and discharging mechanism, ample power in the form of a 40-hp. 4-cylinder gasoline engine and drum capacity of 30 cu.ft. water measurement. On the Koehring machines the new features are an automatic balanced valve for the water supply, operated by the skip; a plumbing device for maintaining the derrick mast vertical when loading batch boxes even when the machine stands on a slope; and a low head-frame cutting down the clearance height for municipal work. The Smith paver has a new and improved water tank and valve and a self-cleaning feature has been introduced into the crawler tread; otherwise the machine

is the same standard model which has been performing successfully for the past three years. Few changes have been made in the Chain Belt paver, the chief innovation being a new automatic water valve and a guard.

A double-pivoted skip to speed up the loading operation is a recent improvement on the Foote mixer; this machine has a two-door bucket permitting a clear opening for free discharge. The derrick loader is in the form of a horizontal steel boom which swings to command both sides of the machine.

Of the side-loading machines for building and general construction the 21-ft. Marsh-Capron unit was of the rail track type with a cable-equalizing casting on the corners of the skip to insure a level pull-up, even when the mixer stands on a slope. This machine has incorporated a stake-locking device on its form which holds the rails to grade even on soft material. The same company also is marketing a new form-puller for raising a 10 ft. section in one operation instead of withdrawing stakes individually. A new anchor-lock joint with a length of 15 in. compared with a former length of 5 in. was shown by Heltzel; it has a swiveling wedge plate which brings the top surface of adjacent rails to the same level and insures a smooth, rigid connection.

A road rail form of heavy metal (10 gage) was shown by the Metal Forms Corporation. No important change has been made in this equipment except for the provision of slightly more side play at the joints to facilitate setting on curves. The new feature of this company's exhibit was its aligner clamp



ROAD SHOW'S DISPLAY OF SHOVELS, CONCRETE MIXERS, TRENCHING MACHINES AND OTHER HEAVY EQUIPMENT (LOOKING SOUTH)

is sold with the guarantee of a definite trade-in. value and rebuilding cost. The Standard Scale & Supply Corporation showed for the first time its new 26x54-in. narrow drum mixer, size 7-S; a gear drive eliminates all belts and chains. New models of the 7-S mixer with power loader also were shown by Lakewood and Leach (formerly Oshkosh). The new 4-S Smith tilter has a power loader.

Finishing Machines

The chief new feature of the Lakewood finisher was an adjustable strike-off, which operates as much as 4 in. below the top of the side form. This feature is valuable in striking off concrete before placing reinforcement or for spreading the bottom course in a two course pavement.

Only two working members, the front and rear screeds, are incorporated in the Ord surfacer shown by A. W. French & Co. In operation pressure is exerted by the concrete which piles up in front of the forward screed while the latter kneads the surface below it.

Road Forms

Manufacturers of steel forms for concrete roads are laying stress upon rigidity and large bearing area to prevent depressions in the finished surface and consequent damage by impact from moving traffic. The Blaw Knox Co. for handling a number of flat wall form units in one operation. To meet county specifications in Illinois a new curb and gutter form with rolled surfaces was developed. Lakewood showed its Carr line-point form with wedge locks at the joints.

Transport

Industrial Locomotives

Variable speed was the feature of the gasoline industrial locomotives exhibited by Fate-Root-Heath, Milwaukee, Davenport and Whitcomb. The manufacturer first named has adopted a gear drive for all models and on the 7-ton machine a 65-hp. engine replaces the former 47-hp. unit. The Whitcomb company showed a 12 ton machine and the Milwaukee company a 6-ton unit. One of the recent trends in design, as exemplified in the Davenport model, is the enclosure of working parts in oil-tight, dust-proof housings, insuring proper lubrication. On the newest model of Milwaukee locomotives the brake drum is mounted on the drive shaft so that braking is done at this point rather than on the wheel.

Tractors and Trucks

The trend toward complete motorization of road contractors' equipment was reflected in a representative list of tractor exhibits, including Holt, Best, Bear, Monarch, and Avery. Holt showed 10, 5 and 2-ton models, the latter being an adaptation of a farm tractor to light road-grading work. The Monarch tractor was equipped with a new type of rotary snow plow. It consists of an inclined front shoe, a V-shaped prow and a pair of three-blade propellors, chain-driven at a speed of 350 r.p.m. Tractor manufacturers are now emphasizing the dual uses of their machines in the highway field—for grader operation and other haulage in summer, and for snow removal, with plow attachment, in winter. The Gray tractor exhibited last week was equipped as a road maintenance machine functioning as a roller, scarifier and grader; the rear wheel is in the form of a roller with a 54-in. base.

A number of the standard makes of motor truck were on display, many of them equipped with special bodies for road building work.

Portable Pumps and Compressors

Mobility, through mountings on steel or rubber-tired wheels, was a feature of the portable pumps and compressors exhibited. Large capacities are now available in pumps of this type for road building work as exemplified by the C. H. & E. Co.'s triplex unit with 27½ hp. 4-cylinder gasoline engine guaranteed to deliver 70 gal. per minute through 5 miles of 2½ in. pipe, equivalent to a working head of 925 ft. A 500 lb. working pressure is provided in the Barnes portable road builder's pump; it is a triplex machine of the horizontal, outside packed type.

Half a dozen portable compressor outfits were shown. The Sullivan machine, a new model this year, had a 31-hp. engine and a capacity of 170 ft. of air per minute. In this machine chrome nickel steel gears replaced the friction clutch. Forced feed is used instead of splash lubrication and a circulating pump forces water successively through the engine radiator and the compressor and gas engine jackets. One of five sizes of Ingersoll-Rand portable compressor with capacities of from 60 to 250 ft. of air per minute was shown on a rubber-tired wheel mounting. This machine has an improved clutch coup-

ling with only three bolts. Accessory equipment in the form of jackhamers, clay diggers, back-fill rammers, pavement breakers, and riveting hammers were shown. The Chicago Pneumatic Tool Co. builds its portable compressor in three capacities, 28, 60 and 210 cu.ft. of air per minute; in these machines an auto-pneumatic throttle is featured as a saver in fuel and lubricant. A one-drill compressor with a capacity of 80 cu.ft. was shown by the Buhl Co.; in this machine the engine and compressor cylinders are cast en bloc. The Domestic Engine & Pump Co. showed a portable 50 ft. compressor unit.

Hoists

The feature of the Clyde 15-hp. gasoline builder's hoist was a reversible sheave and non-reversible drum. This outfit is used for double-cage elevators; the latter can be locked while unloading and the hoist drum used for other purposes, such as handling concrete buckets or lumber. A winch head also is available for snaking.

Cut gears and machined drums were features of the Mead-Morrison 15-hp. builder's hoist, built as a single-drum machine with provision for bolting on a second drum; this model is known as the Handihoist and is a new model. The O.K. Clutch & Machinery Co.'s hoist also was a single-drum machine with second-drum attachment.

Asphalt Equipment

Heating by kerosene oil is employed in the Kinney pressure distributor for asphalt and tar. It is mounted on a motor truck chassis and is designed to handle both light and heavy grades of bituminous material. The spray nozzles are fed by force pump and the control apparatus gives a range of distribution 1/20 to 2¼ gal. per square yard. Other distributors on display were the White truck outfit and the Tarvia machine of the Barrett Co.

Miscellaneous Equipment

An enlarged batch box car holding two 37-cu.ft. units was shown by the Western Wheeled Scraper Co.

An innovation in the form of highway guard-rail was shown by the Page Steel & Wire Co. in the form of No. 9 gage wire mesh, 1½ x 1½ in. of Armco ingot iron. This material comes in strips 24 in. wide and is attached by staples to posts 8 ft. apart. Great strength and elasticity are claimed for this form of guard rail.

The Russell Grader Mfg. Co. showed its new portable self-contained screening, crushing and loading plant with a capacity rated at from 300 to 600 yd. daily.

A durable highway sign consisting of an asbestos-cement and asphalt with letters of aluminum alloy was shown by the Century Sign Co.

The Erie Steel Construction Co., which has been engaged in the past in the manufacture of bins and concrete aggregate measuring devices, has entered the bucket field with a 1-yard clamshell of rugged design.

Public Roads Exhibit

In addition to the exhibits by manufacturers of equipment and material there was an elaborate display by the U. S. Bureau of Public Roads showing by means of models the several steps in the construction of highways of various types. Other portions of the exhibit showed the results of the Bureau's research program.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Weightings of Factors in E. N-R. Cost Index Change Constantly

It may not be understood by everyone that the weightings of the four factors which comprise *Engineering News-Record's* Construction Cost Index Number vary continually with changing prices. The original weightings were based upon the total annual production of the various materials and their prices in 1913. The labor factor was determined from the number of common laborers (exclusive of farm labor) and the wage rate in 1913. The weightings were obtained by multiplying certain quantities of the several factors by the unit cost of each, the sum of the results equaling 100. The percentages were: steel, 37.5; cement, 7.14; lumber, 17.1; labor, 38.

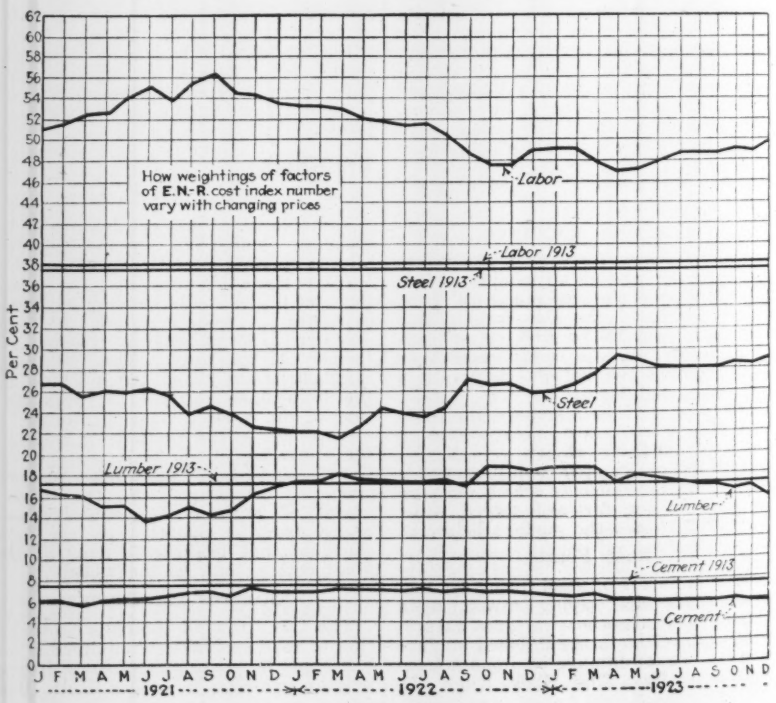
The sum of these percentages equals 99.74 which was considered sufficiently accurate for all practical purposes. Computation of the Number is explained in detail in *Engineering News-Record*, Jan. 3, p. 43.

The chart shows the fluctuation of the four factors over the last three years. It is obvious that the one which is increasing most is the one chiefly responsible for increasing construction cost. It must not be overlooked, however, that the percentage of one factor may be decreasing although the market price of that factor is actually rising. Prices of two or more of the factors may be increasing simultaneously, but one of them may be rising so rapidly as to lower the percentage of one of the other factors whose price is increasing at a slower pace. Again, it is clear that a ten-cent rise in steel will increase the percentage of the steel factor much more than will a ten-cent rise in the price of cement, due to the greater value of steel in the Index Number. Steel rising from $2.50 per 100 lb. to $2.60 will add 3.1 points to the Number. An identical rise in cement will add 0.6 point. This is because the importance of steel in general construction, all things considered, is much greater than that of cement.

In view of the importance given to steel it may be argued that this factor will dominate the Cost Index Number. This is not the case. Omitting steel entirely from the Index Number and giving labor a weighting of 47.70 per cent, cement 23.8 per cent, and lumber 28.5, the Number on Jan. 1, 1924, would be 236, against the official *E. N.-R.* Index of 218. As another example, use the following weightings: steel, 0; cement, 25; lumber, 25; labor, 50. The Jan. 1, 1924 Index would be 203.

Steel is a valuable factor in the *E. N.-R.* Cost Index Number, since it enters so fundamentally into construction, and is so sensitive to changing business conditions. As has often been said, steel is one of the best business barometers.

The chart shows that labor is the only factor in the Number that has greatly increased its proportion. Originally 38 per cent; in September 1921, it touched 56, and at present is about 50. Steel lost the most weight, dropping to 22 per cent in March 1922, and standing at 29 per cent on Jan. 1, 1924. Lumber and cement have held closely to their original percentages, despite considerable price advances since 1913.



Municipal Bond Sales Gain in December

The December sale of bonds was larger than the total for any one of the three preceding months. The *Commercial and Financial Chronicle* reports the December disposal of bonds to total $103,318,192. This is an increase of $7,465,593 over the November sales and $37,168,792 larger than the aggregate of December 1922. Several large state issues helped to swell awards of last month. The state of Illinois stands out prominently with an issue of $21,000,000. New Jersey placed an award of $8,000,000 with various banks for roads and highways. The states of Minnesota and Michigan issued several large blocks.

Milwaukee County, Wis., placed an issue of metropolitan sewerage bonds for the amount of $4,200,000.

The city of Boston disposed of several issues totaling $3,045,000.

In the accompanying table of the December issue of bonds, six were sold at par, seven below par and the remainder above. The yields range from 4 to 6 and the rate of interest from 4 to 6 per cent.

The largest number of awards (22) were issued at 5½, four at 4, eight at 5, and six at 6 per cent.

The issues of December, 1923, may be compared with the totals of this month in the last five years:

	Dec.	Year 1923
1923	$103,318,192	$1,026,151,641
1922	66,149,400	1,100,717,313
1921	220,466,661	1,208,548,274
1920	55,476,631	683,188,255
1919	62,082,923	691,518,914

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers have been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Large lumber mill to be erected in British Colombia. Mill to have capacity of 100,000,000 feet of lumber a year. Power and lighting plant to be erected to run mill. Reference No. 117,916.

Construction work in Nicaragua—Large concrete wharf, creosoting plant, wireless station, large electric light plant, turpentine distillery are the items listed. It is stated that a definite opportunity exists for the sale of American materials and machinery. Reference No. 117,879.

Subway for Genoa — Total underground construction of 15½ miles is to be done. First unit is 2½ miles with nine intermediate stations. Reference No. 117,354.

Waterworks for City in Bulgaria—Complete new system with source of water about 50 miles south of the city. The estimated cost is about $5,000,000. Reference No. 117,372.

Business Briefs

Call money quiet at 4 per cent, Jan. 21.

Time loans slow at 4¾ per cent.

Commercial paper unchanged with rates at 4¾@5 per cent.

Foreign exchange weaker and lower. Sterling, $4.20¼; last week, $4.23¼; year ago, $4.65½. Franc, $0.0443½; last week, $0.0437; year ago, $0.0634. Lira, $0.0433; last week, $0.0439; year ago, $0.0472.

REPRESENTATIVE PUBLIC BOND SALES, DECEMBER, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Illinois	Highway	$15,000,000	4¼	100.83	4.65	Aug. 1	1924—43	A Syndicate
		6,000,000	4	94.46	4.50	Mar. 1	1937—42	Speyer & Co. and others
Michigan	Roads	2,540,000	4½	100	4.42	Dec. 1	1943	Syndicate
		460,000	4					
Minnesota		1,800,000	4	100	4	Nov. 1	1943	A Syndicate
		3,200,000	4½	100.002	4.48	Nov. 1	1943	
New Jersey	Roads and highway	8,000,000	4½	100.88	4.23	.....	.....	Various banks
County								
Benton, Ind.	Ditch	14,512	6	100	6	Oct. 10	1924—28	Edw. O'Gara, Lafayette, Ind.
Bergen, N. J.	Improvement	429,000	4½	100.04	4.49	Dec. 1	1924—48	J. S. Rippel & Co., Newark
Deschutes, Ore.	Roads	50,000	5½	101.75	5.07	Nov. 1	1929—43	Citizens Bank of Portland
Escambia, Fla.	Roads	250,000	6	.....	....	Aug. 15	1937—41	Caldwell & Co. and others, Birmingham
Franklin, O.	Sewer	63,100	5½	102.37	5	Nov. 15	1925—33	W. L. Slayton & Co., Toledo
Green, Ia.	Road	100,000	5	.....	....	Dec. 1	1930—32	Second Ward Securities Co., Milwaukee
Hinds, Miss.	Road and bridge	100,000	5½	.....	....	Jan. 15	1925—44	Smith, Moore & Co.
Hudson, N. J.	Roads	986,000	4½	100	4½	Aug. 1	1924—42	A. M. Lamport & Co., New York City
	Boulevard	386,000	4½	100	4½	Aug. 1	1924—38	
Lancaster, Nebr.	Paving	95,000	5½	100.855	5½	Jan. 1	Serially	Omaha Trust Co.
Lucas, O.	Sewer	138,872	5½	101.71	5.17	Nov. 15	1925—33	A Syndicate
	Sewer	54,541	5½	102.50	5.01	Nov. 15	1925—33	
	Road	52,910	5½	102.50	5.01	Nov. 1	1925—33	
	Road	51,851	5½	102.50	5.01	Nov. 1	1925—33	
	Water	47,149	5½	102.60	4.99	Nov. 15	1925—33	
	Road	21,163	5½	101.95	5.05	Nov. 1	1925—33	
	Road	7,195	5½	101.16	5.17	Nov. 1	1925—33	
	Water	29,755	5½	102.20	5.04	Nov. 15	1925—33	
	Water	29,808	5½	102.20	5.04	Nov. 15	1925—33	
	Road	9,735	5½	101.11	5.19	Nov. 1	1925—29	
	Water	3,739	5½	100.55	5.32	Nov. 15	1925—27	
	Water	57,016	5½	102.72	4.97	Nov. 15	1925—33	
	Sewer	45,565	5½	102.58	5.00	Nov. 15	1925—33	
	Total	$549,299						
Milwaukee, Wis.	Sewer	4,200,000	4½	100.192	4.73	Dec. 18	1934—43	A Syndicate
Orleans, N. Y.	Roads	91,000	5	104.10	4.31	May 1	1930—31	Sherwood & Merrifield, New York City
Pipestone, Minn.	Ditch	18,000	4¼	99.75	4.76	Jan. 1	Serially	Capital Trust & Savings Bk., St. Paul
Pike, Ky.	Road and bridge	250,000	5	100.81	4.94	July 1	1928—53	National City Co. of New York
Pulaski, Ind.	Ditch	35,700	5½	102.71	4.51	Dec.	1925—28—34	Fletcher American Co. of Indianapolis
Ramsey, Minn.	Road and bridge	1,000,000	4@5	100	4.75	Jan. 2	1925—36—44	Eldredge & Co. and others
Richland, O.	Roads	82,000	5½	101.47	5.16	Oct. 1	1924—32	Seasongood & Mayer
Stark, O.	Improvement	210,000	5½	102.53	5.01	Dec. 1	1925—33	Prudden & Co.
Suffolk, N. Y.	Roads	125,000	4½	102.11	4.22	Jan. 1	1925—39	Geo. B. Gibbons & Co.
Washington, Ore.	Improvement	30,000	6.00	98.12	6.35	Dec. 1	1928—32	Ralph Schneelock Co.
Warren, Miss.	Road and bridge	300,000	5½	101.32	5.17	.....	.....	Burr and Breed and others
Township								
Amanda, O.	Road	13,000	5½	100	5½	Oct. 1	1924—33	Buckeye Commercial Bank & Savings Co.
Chester, O.	Road	11,000	6	101.90	5.64	Nov. 1	1921—31	Spitzer, Rorick & Co.
Woodbridge, N. J.	Improvement	350,000	5½	100.50	5.47	Dec. 1	1927	R. M. Grant & Co.
Municipalities								
Albany, N. Y.	Public improvement Water Street	1,074,000	4½	100.09	4.20	Dec. 1	1924—63	Clark Williams & Co., and others
Ashtabula, O.	Sewage Storm drain	200,000	5½	104.531	5.02	Oct. 1	1924—48	Herrick Co.
		62,500	6	101.81	5.34	Oct. 1	1924—28	
Boston, Mass.	Improvement	3,045,000	4¼	100.23	4.19	Jan. 1	Serially	Old Colony Trust Co. and others
Cheraw, S. Car.	Paving	200,000	5½	100	5½	Oct. 15	1924—53	Bank of Charleston
Daytona, Fla.	Improvement	410,000	5	96.68	5.31	Nov. 1	1925—53	Merchants Bank & Trust Co.
Kenosha, Wis.	Improvement	154,357	6	100	6	July 1	1924—33	First Natl. Bank and others
Kansas City, Kan.	Improvement	380,000	5	100.09	4.99	Aug. 1	1924—33	Eldredge & Co. of N. Y.
Knoxville, Tenn.	Improvement	2,750,000	4½	98.31	4.92	Nov. 1	1926—48	Syndicate of N. Y. Bankers
Lansing, Mich.	Improvement	1,800,000	4½	99.35	4.55	Jan. 2	1934—53	Eastman Dillon & Co., and others
Memphis, Tenn.	Improvement	2,000,000	5@4½	100.2808	4.86	July 1	1924—63	National City Co.
Manchester, N. H.	Improvement	250,000	4	95.27	4.47	July 1	1924—43	A. B. Leach & Co., N. Y.
Toledo, O.	Sewer, etc.	650,000	5	103.27	4.65	Oct. 1	1925—47	C. W. McNear & Co. and others

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 43 to 55, are the following:

Club, Indianapolis, Ind., for Columbia Club, $1,000,000.

Hospital, Kings Park, N. Y., State Hospital Comm., $1,000,000.

Hospitals, Cleveland, O., Babies and Childrens Hospital, $3,300,000.

Drainage and levee work, Lake Village, Ark., Chicot Co., D. D., $1,400,000.

Bridge, Mendota, Minn., Hennepin Co., over $1,000,000.

Hospital, Cedargrove, N. J., Essex Co., $1,000,000.

Larger Contracts Let During Week

Among the week's announcements of Contracts awarded in Construction News, pp. 43 to 55, are the following:

Office, Detroit, Mich., Buhl Land Co. to Davis and McGonigle Co., $5,000,000.

Nurses Home, Detroit, Mich., Ford Hospital to O. Misch and Co., $1,500,000.

Repair Shop, New York, N. Y., to Willetts Constr. Co., $2,325,000.

School, Bellaire, N. Y., to Hayson Constr. Co., $1,007,000.

High School, Paterson, N. J., to McGee Constr. Co., $1,000,000.

Bridge, Florida between Pensacola and Milton, to Hardaway Contg. Co., $513,248.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Jan. 3; the next, on Feb. 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$3.85	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.00	5.30	5.00	4.05	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.25	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	—53.2%	43%	47%	53–5%	36%	37.10@47.40%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	+56.00	61.00	57.20@60.20	60.50	67.00	57.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	2.00	+2.00	—2.00	2.00	1.85	1.90	2.15	+1.50	1.50
Sand, cu.yd.	1.25	+1.42	2.00	2.00	1.25@1.50	1.00	1.50	+1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.75	+2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	60.00	+38.00	54.75	55.50	44.75@46.00	57.00	38.00	+30.50	65.00
Lime, finishing, hydrated, ton	18.20	—22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	+1.65	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	23.65	+12.00	11.60	11.00	16@18	12.00	15.50	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.95	+.98	1.07	.94	1.01	1.10	1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.30	.....	.....	.....	.50@.55	.55	.62½	...
Common labor, non-union, hour	....	.25	.30@.50	.82½	.40@.45	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Weekly Review of the Market

The price situation, particularly in the basic building materials, is one of decided firmness, according to *Engineering News-Record's* weekly survey of market conditions. Increased demand is noticeable in iron, steel and textiles, while a slight decrease is reported in the leather industry.

Although there is curtailment in many industries, present conditions are exactly opposite those of a year ago, in that purchasing is now confined to actual requirements and shows little tendency toward speculation.

In the building materials' market, firmness is noted in c.-i. pipe, sand, gravel, crushed stone, pine and fir timbers, lump lime, common brick and linseed oil, in the nine cities reporting weekly to *E. N.-R.* Slight declines, however, are reported on steel pipe and hydrated lime in Atlanta and ¾-in. gravel in Dallas.

A strengthening of the lumber movement of the country followed close upon the holiday slump. Marked increases are noted in production, shipments and orders, compared with the week of Dec. 29.

The steel situation is briefly described as follows: Structural steel sales for December, heaviest since April, 1923, and 31 per cent greater than for corresponding month in 1922. Fabricators working at 81 per cent of capacity with greater volume of bookings ahead than has been realized during any month since March, 1923. No. 2 foundry iron firmer at Birmingham. Maximum quotation $23, against $22 per ton last week. Better demand for basic iron. Pig-iron output slightly increased. Iron and steel scrap prices tending higher. While there is no immediate prospect of higher steel prices, the increase in December unfilled tonnage shows an awakening of demand; this would serve to forestall any decline from the $2.40 base on bars and $2.50 per 100 lb., level for plates and shapes. Active buying in steel sheets.